DOE/EIA-0555(95)/1

Energy Consumption Series

Buildings and Energy in the 1980's

June 1995

Energy Information Administration

This publication and other Energy Information Administration (EIA) publications may be purchased from the Superintendent of Documents, U.S. Government Printing Office.

Telephone orders may be directed to:

Superintendent of Documents
U.S. Government Printing Office
Main Order Desk
(202) 512-1800
FAX: (202) 512-2250
8 a.m. to 4:30 p.m., eastern time, M-F

All mail orders should be directed to:

U.S. Government Printing Office
P.O. Box 371954
Pittsburgh, PA 15250-7954

Complimentary subscriptions and single issues are available to certain groups of subscribers, such as public and academic libraries, Federal, State, local and foreign governments, EIA survey respondents, and the media. For further information and for answers to questions on energy statistics, please contact EIA's National Energy Information Center. Address, telephone numbers, and hours are as follows:

National Energy Information Center, EI-231
Energy Information Administration
Forrestal Building, Room 1F-048
Washington, DC 20585
(202)586-8800
Internet E-Mail: INFOCTR@EIA.DOE.GOV
TTY: For people who are deaf or hard
of hearing: (202)586-1181
9 a.m. to 5 p.m., eastern time, M-F

Released for Printing: June 8, 1995
GPO Stock No.: 061-003-00914-0

Printed with soy ink on recycled paper

DOE/EIA-0555(95)/1
Distribution Category UC-950

Energy Consumption Series

Buildings and Energy in the 1980's

June 1995

Energy Information Administration
Office of Energy Markets and End Use
U.S. Department of Energy
Washington, DC 20585

Contacts

This publication was prepared under the general direction of W. Calvin Kilgore, Director of the Office of Energy Markets and End Use (202/586-1617), and Lynda T. Carlson, Director of the Energy End Use and Integrated Statistics Division (EEUISD) (202/586-1112). Specific information regarding the contents or preparation of this publication can be obtained from Dwight K. French, Chief of the Transportation and Industrial Branch (202/586-1126). Questions regarding the Commercial Buildings Energy Consumption Survey (CBECS) may be referred to Martha M. Johnson, Survey Manager (202/586-1135). Questions regarding the Residential Energy Consumption Survey (CBECS) may be referred to Wendel Thompson, Survey Manager (202/586-1119). The FAX number for all EEUISD personnel is 202/586-0018.

Detailed technical questions on the topics in this publication may be referred to the following members of EEUISD:

Alan Swenson	Principal Author	(202) 586-1129	aswenson@eia.doe.gov
Eugene M. Burns	Technical Advisor	(202) 586-1125	eburns@eia.doe.gov
Christy Hall	Appendices	(202) 586-1068	chall@eia.doe.gov
Stephanie J. Battles	Appendix C Calculation of Energy Price Indices	(202) 586-7237	sbattles@eia.doe.gov

The following persons also made important contributions to this publication:

Hattie Ramseur	Report Production	(202) 586-1124	hramseur@eia.doe.gov
Linda Owens	Technical Monitor	(202) 586-5891	lowens@eia.doe.gov

Contents

Tables

Figures

1. Highlights

Introduction

The Energy Information Administration (EIA) collects data on energy consumption, expenditures, and other energy-related topics in the major energy-consuming sectors of the U.S. economy. The residential and commercial sectors are two major sectors that many energy analysts like to consider together, as energy use is primarily related to the building shell and the stock of energy-consuming goods within the shell in these sectors. EIA conducts separate surveys for the two sectors, the Residential Energy Consumption Survey (RECS) and the Commercial Buildings Energy Consumption Survey (CBECS).[1] Prior to the first CBECS, there was a very poor understanding of the complexities of energy use in commercial buildings, or the amount of energy consumed in the commercial sector. This report summarizes and synthesizes energy data that were collected by these two surveys during the 1980's, when major changes in energy policy were implemented following the energy crisis decade of the 1970's.

The six RECS and four CBECS data bases from the ten consumption surveys over the 1979 to 1990 time frame contain a wealth of energy end use information on residential and commercial buildings. This is the first report to present a unified vision of energy use in residential and commercial buildings. This report presents energy data that are consistent between the two sectors and across the decade of the 1980's. This report differs from previous consumption reports because all consumption statistics are reported in terms of primary electricity consumption and site energy for all other energy sources.[2]

The availability of inexpensive, secure energy became less certain by the early 1970's. Although energy demand (total energy consumption, Figure 1.1) had continued its long rise into the 1970's, the production of domestic oil (a primary source of energy) peaked in 1970 and forced greater reliance on energy imports. The Arab oil embargo in 1973-1974 served as the catalyst for the energy crisis; oil supplies were constrained and energy prices rose sharply. In both the 1970's and 1980's, the price of oil had a large impact on the economy, the price of other fuels, and on total energy consumption. Both the sharp price increase in 1974 and again in 1979 (following the 1978 Iranian revolution) contributed to economic downturns and fueled much of the high inflation of the period.

During the 1970's, the promise of higher energy prices for the foreseeable future and the uncertainty of adequate supplies led to public discussion and development of a comprehensive energy policy that could produce long-term solutions to the energy crisis. Four generally agreed upon goals of the policy were: adequate energy supplies, reduced dependence on energy imports, protection against the disruption of foreign supplies, and increased conservation and efficiency in end uses.

Many energy programs were put into place during the 1970's and 1980's to lessen the dependence upon foreign oil supplies and to improve how all forms of energy are used. A significant percent of total energy consumption occurred in the residential and commercial sectors (Figure 1.2). This report concentrates on the physical makeup of the residential and commercial buildings sectors and their use of energy, and examines changes that occurred during the 1980's.

The remainder of this chapter presents a summary of major findings. The following three chapters focus on different aspects of the overarching theme of buildings and energy in the 1980's. Chapter 2 discusses major characteristics

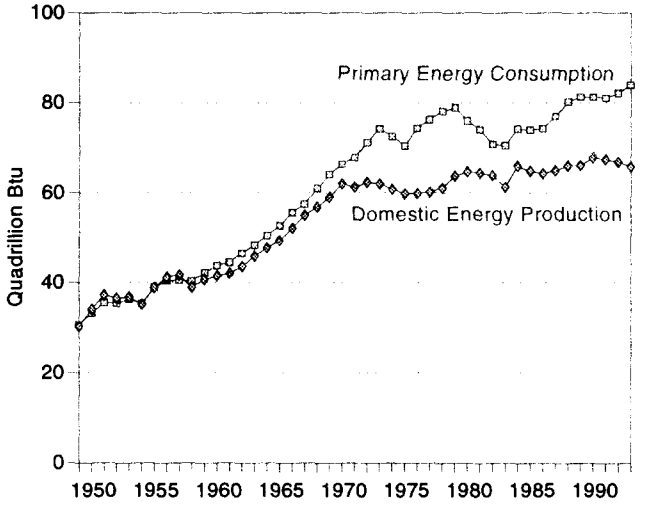
---

[1]Residential Energy Consumption Surveys were conducted in 1980, 1981, 1982, 1984, 1987, and 1990. Commercial Buildings Energy Consumption Surveys were conducted in 1979, 1983, 1986, and 1989. Prior to the 1989 CBECS, that survey was called the Nonresidential Buildings Energy Consumption Survey. The RECS and CBECS are presently conducted triennially and each supports two major publications, one covering buildings characteristics, and one covering energy consumption and expenditures.

[2]Primary electricity consumption takes into account the energy inputs used to produce and transmit electricity. Site energy consumption is the amount of energy delivered to a site. See Appendix C, "Data Quality."

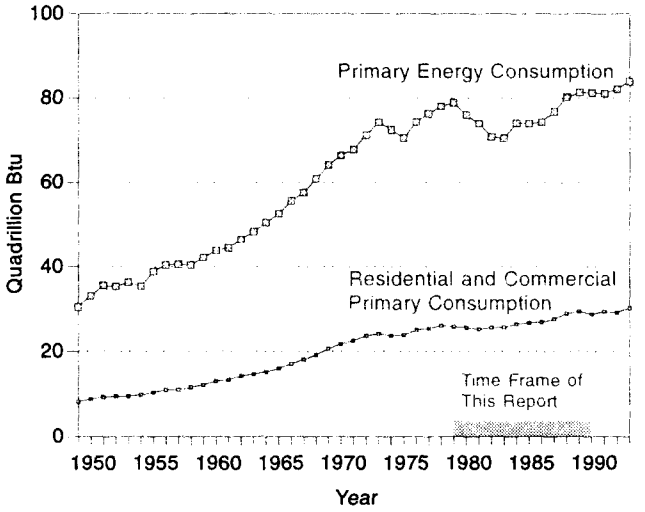
of residential and commercial buildings. Chapter 3 considers the major energy sources and end uses in terms of number of buildings and floorspace. Chapter 4 focuses on energy consumption and expenditures. Chapters 2, 3, and 4 contain tables at the end of each chapter that summarize data from detailed tables that are available separately on diskette or via EIA's Electronic Publishing System (EPUB). Following the body of the report, appendices and a glossary provide additional information on the methodologies used in this report and on the residential and commercial building consumption surveys on which this report is based.

Figure 1.1. Domestic Energy Production and Primary Domestic Energy Consumption, 1949-1993



Source: Energy Information Administration, *Annual Energy Review 1993*, DOE/EIA-0384(93).

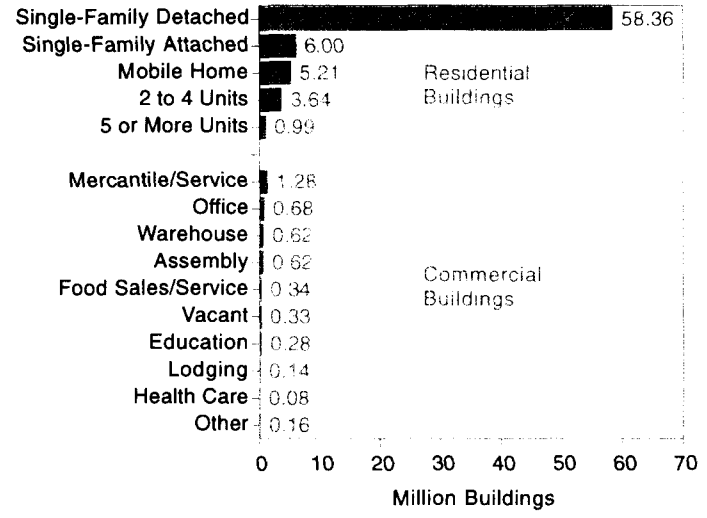
Figure 1.2. Primary Energy Consumption and Primary Residential and Commercial Consumption, 1949-1993



Source: Energy Information Administration, *Annual Energy Review 1993*, DOE/EIA-0384(93).

Dominance of Single-Family Detached Homes

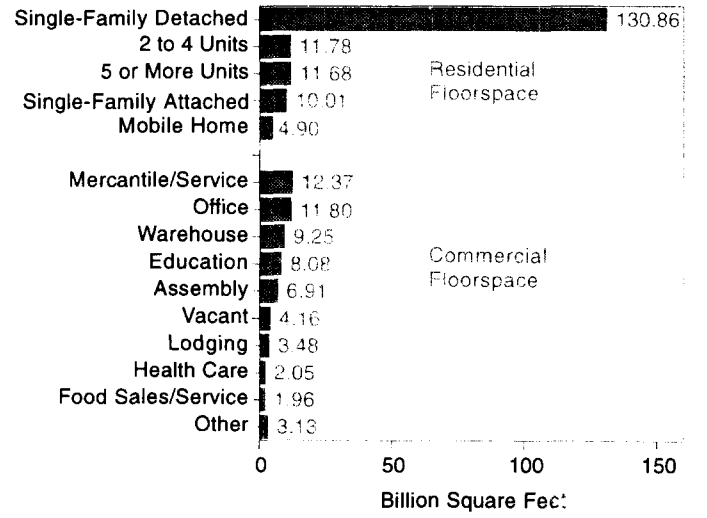
Figure 1.3. Number of Residential and Commercial Buildings by Type of Building, 1990 RECS and 1989 CBECS



Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1990 Residential Energy Consumption Surveys and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

- Single-family detached homes exceeded all other building types combined in both number of buildings and total floorspace (Figures 1.3 and 1.4).
- Single-family detached homes accounted for nearly three-fourths of the buildings in the two sectors (Figure 1.3).
- Commercial buildings constituted only six percent of buildings in both sectors.
- All other residential building types combined represented one-fifth of the total.

Figure 1.4. Total Residential and Commercial Floorspace by Type of Building, 1990 RECS and 1989 CBECS

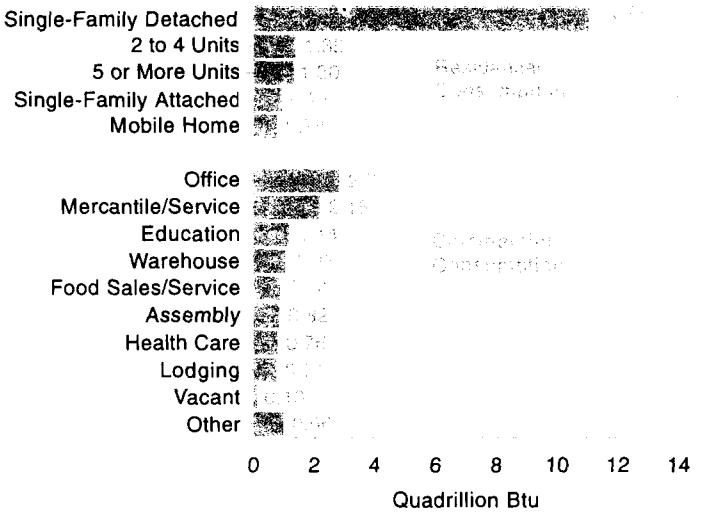


Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1990 Residential Energy Consumption Surveys and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

- Single-family detached homes accounted for more than half of residential and commercial floorspace (Figure 1.4).
- Commercial buildings represented slightly more than one-fourth of residential and commercial floorspace, a larger share than the number of buildings because of their larger average size.
- All other residential buildings constituted less than one-fifth of residential and commercial floorspace.

- Consumption and expenditures for energy in single-family detached homes exceeded those for all other building types (Figures 1.5 and 1.6).
- Consumption in single-family detached homes was 41 percent of the total, slightly less than the total for all commercial buildings (Figure 1.5).

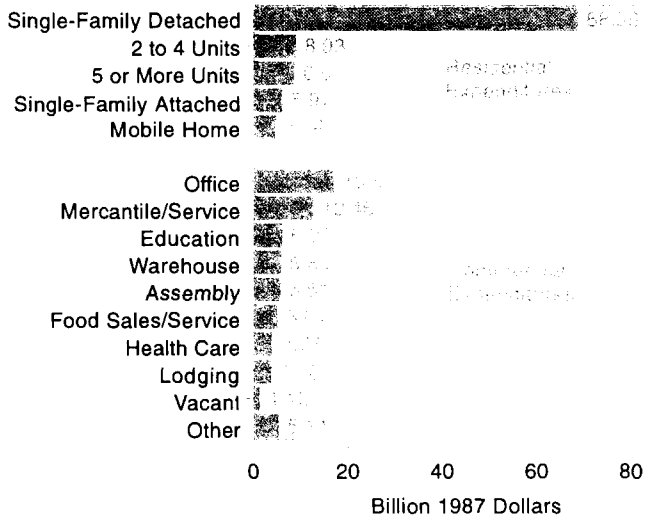
Figure 1.5. Total Residential and Commercial Primary Consumption by Type of Building, 1990 RECS and 1989 CBECS



Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1990 Residential Energy Consumption Surveys and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

- Expenditures (in 1987 dollars) for single-family detached homes were about 44 percent of the total for both sectors, and about 5 percent more than the total expenditures for all commercial buildings (Figure 1.6).

Figure 1.6. Total Residential and Commercial Energy Expenditures (1987 Dollars) by Type of Building, 1990 RECS and 1989 CBECS*



*See Appendix C, "Data Quality", for adjustment to 1987 dollars.

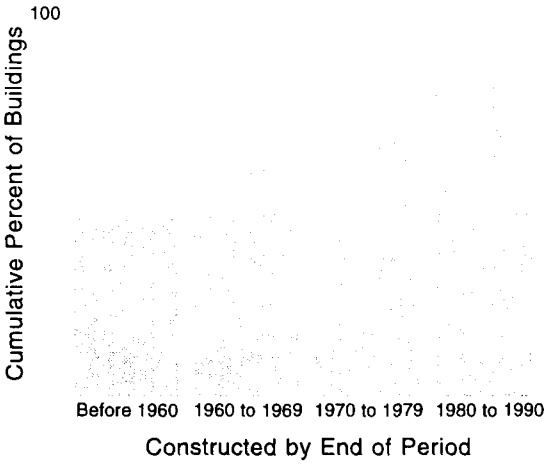
Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1990 Residential Energy Consumption Surveys and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

Age Distribution of Buildings

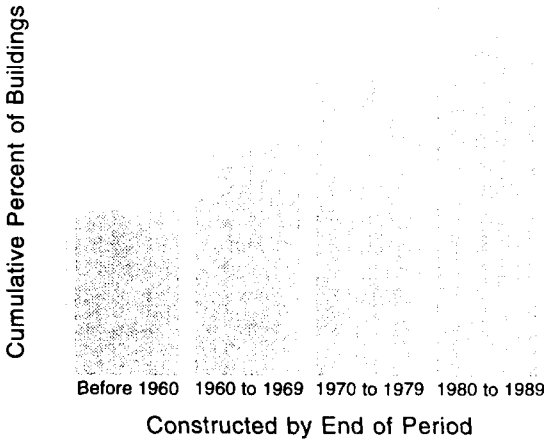
The relatively slow turnover in the building stock is revealed in both the RECS and CBECS data. Residential and commercial buildings constructed during the 1980's represent a small fraction of the entire stock--only 17 percent of residential buildings and 19 percent of commercial buildings (Figures 1.7a and b). Because the bulk of the present building stock was constructed prior to 1980, energy efficient building practices employed in new construction in the 1980's will have greater impact in the future as the older, less efficient stock is retired, and new construction with efficiencies equal or superior to those of the 1980's construction takes its place.

Figure 1.7. Distribution of Buildings and Floorspace by Year Constructed

a. Residential Buildings, 1990



b. Commercial Buildings, 1989



Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1990 Residential Energy Consumption Surveys and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

- At the end of the 1980's, buildings more than 30 years old (constructed before 1960) constituted a substantial fraction of the building population (Figures 1.7a and b).

- Greater than 46 percent of residential buildings and more than 43 percent of commercial buildings were constructed prior to 1960.

- The median age of both residential and commercial buildings at the end of the decade was just under 30 years. If this median age holds, 1980's and newer construction will not represent a majority of buildings until approximately 2010. If the median age increases, this date would be extended even further.

Major Energy Sources--Trends in Use and Consumption

Electricity and natural gas have been and continue to be the energy sources of choice (as measured by the percent of buildings that use them) in both residential and commercial buildings.[3] The use of fuel oil, the third choice, declined during the 1980's.

Electricity

- Use of electricity was nearly universal in residential buildings, and was only slightly less in commercial buildings (those that did not use it in the 1980's were primarily warehouses or vacant buildings) (Figures 1.8a and b).

- Electricity consumption exceeded natural gas consumption and consumption by all other energy sources in both sectors (Figures 1.9a and b).

Natural Gas

- Natural gas was used in about 60 percent of buildings. The slight declines over time shown in Figures 1.8a and 1.8b are not statistically significant.

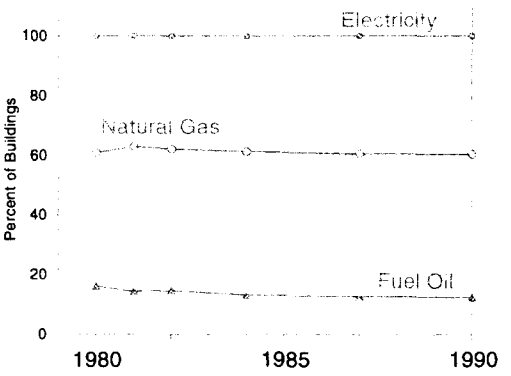
- Natural gas consumption was second to electricity consumption in both sectors. At the beginning of the decade, natural gas consumption was two-thirds that of electricity in residential buildings and 38 percent of that in commercial buildings. By the end of the decade, natural gas use was 53 percent of electricity use in residential buildings and one-fourth that of electricity in commercial buildings (Figures 1.9a and b).

Fuel Oil

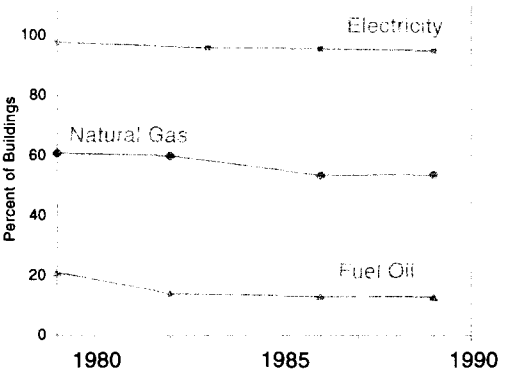
- During the 1980's, the proportion of buildings that used fuel oil declined as did the total consumption of fuel oil in both residential and commercial buildings (Figures 1.8 a and b, 1.9a and b). Fuel oil use was regional, primarily limited to the Northeast and part of the South Census regions.

Figure 1.8. Use of Major Energy Sources for Any Use in the 1980's*

a. Residential Buildings



b. Commercial Buildings



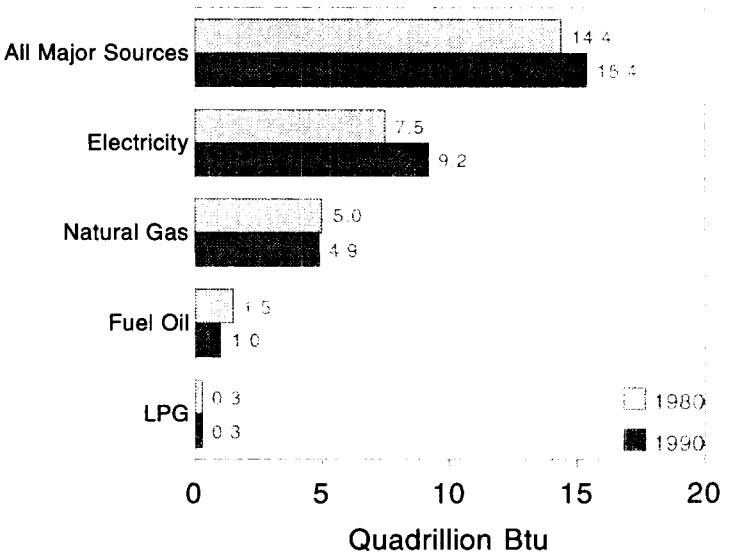
*In commercial buildings, fuel oil use includes kerosene.

Sources: Energy Information Administration, Office of Energy Markets and End Use, Forms EIA-457 of the 1980, 1981, 1982, 1984, 1987, and 1990 Residential Energy Consumption Surveys; Forms EIA-143, 788, and 871 of the 1979, 1983, and 1986 Nonresidential Buildings Energy Consumption Surveys; and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

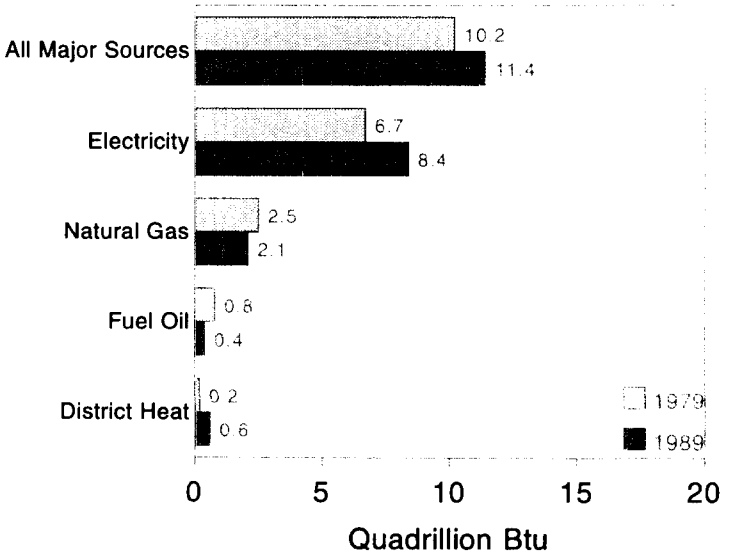
[3]Electricity energy consumption is expressed as primary consumption. Energy consumption is not adjusted for the effect of weather.

Figure 1.9. Primary Energy Consumption by Major Energy Sources*

a. Residential Buildings, 1980 and 1990



b. Commercial Buildings, 1979 and 1989



*All major energy sources and electricity consumption refer to primary electricity consumption. Fuel oil consumption includes kerosene. In residential buildings kerosene was less than 10 percent of total fuel oil consumed. It is not reported separately in commercial buildings.

Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1980 and 1990 Residential Energy Consumption Surveys; Form EIA-143 of the 1979 Nonresidential Buildings Energy Consumption Survey, and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

Major Electricity and Natural Gas End Uses

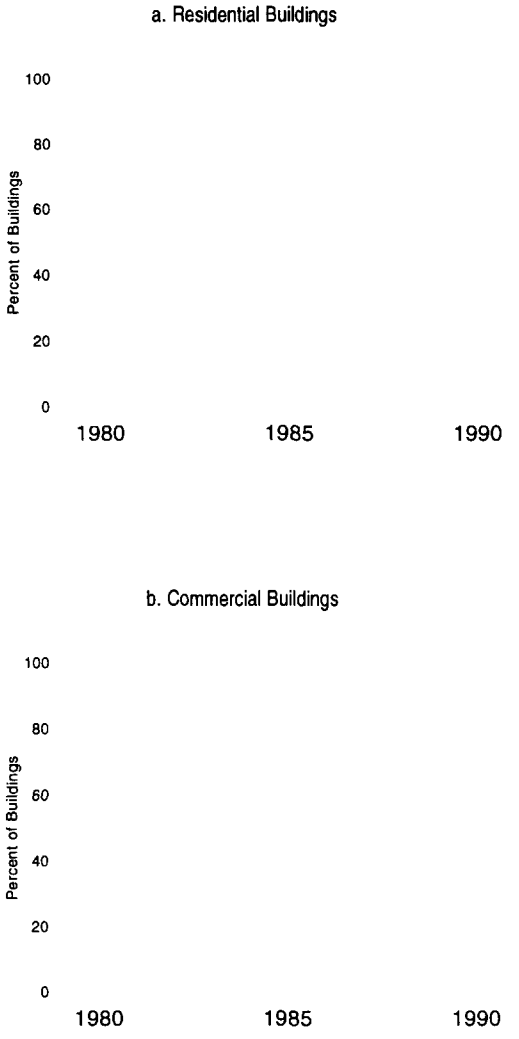
Electricity

- Excluding appliances and lighting, which used electricity almost universally, electricity use was most common for air conditioning (or cooling), followed by water heating and space heating in both residential and commercial buildings (Figures 1.10a and b).
- During the 1980's, the proportions of residential buildings that used electricity for main space heating and air conditioning showed a statistically significant increase. The slight increase shown in Figure 1.10b is not statistically significant.
- Lighting was the major consumer of electricity in commercial buildings, while appliances (which included lighting) was the major consumer in residential buildings. Both of these end uses exceeded any other end use by more than a factor of two (Figures 1.11a and b).

Natural Gas

- Nearly identical percentages of residential buildings used natural gas for main space heating and water heating, whereas in commercial buildings, use for space heating was greater than use for water heating by about 20 percentage points throughout the decade (Figures 1.10a and b). These showed no significant changes during the 1980's.
- In residential and commercial buildings, space heating and water heating were the two main uses of natural gas, with space heating accounting for about three times as much consumption as water heating (Figure 1.11a and b). Other natural gas end uses include range tops or burners, ovens, and clothes dryers.

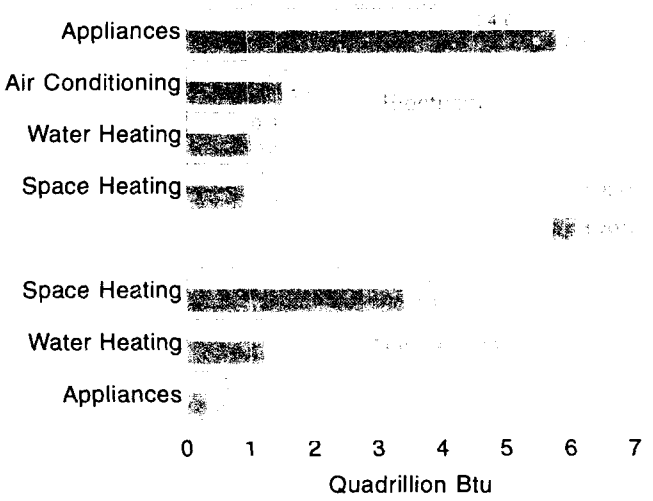
Figure 1.10. Percent of Buildings Using Major Energy Sources for Major Energy Uses in the 1980's



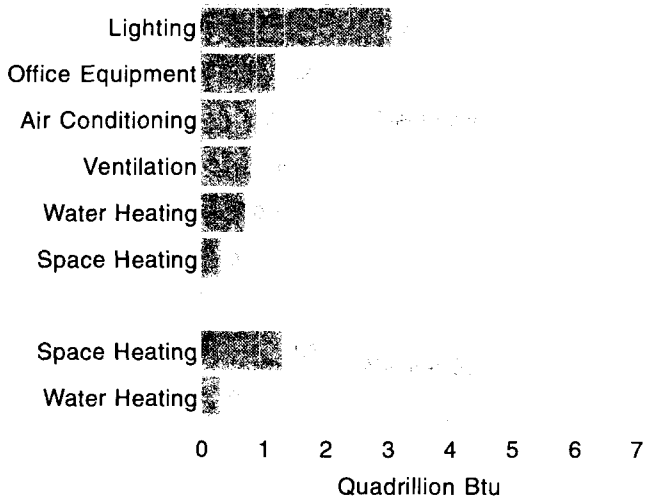
Sources: Energy Information Administration, Office of Energy Markets and End Use, Forms EIA-457 of the 1980, 1981, 1982, 1984, 1987, and 1990 Residential Energy Consumption Surveys; Forms EIA-143, 788, and 871 of the 1979, 1983, and 1986 Nonresidential Buildings Energy Consumption Surveys; and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

Figure 1.11. Major Energy Source Consumption by End Use*

a. Residential Buildings, 1980 and 1990



b. Commercial Buildings, 1989



*Electricity consumption is primary consumption. End-use consumption estimates in commercial buildings are available only for the 1989 CBECS. Space heating and air conditioning are not adjusted for the effect of weather.

Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1980 and 1990 Residential Energy Consumption Surveys and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

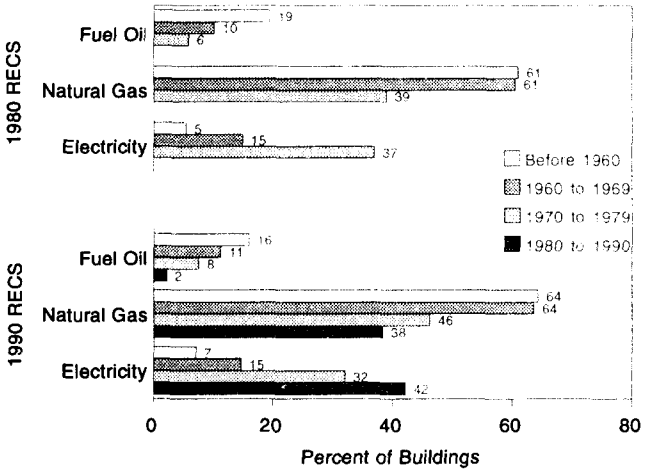
Space Heating Energy Sources and Year of Building Construction

The distribution of energy sources used for space heating by year constructed reveals interesting trends in the 1980's. These trends continued the historic rise and fall of different energy sources as the primary choices for heating buildings: first wood (which peaked in the late 1800's), then coal (which peaked during World War II), and then the three sources most commonly used today--fuel oil, natural gas, and electricity.

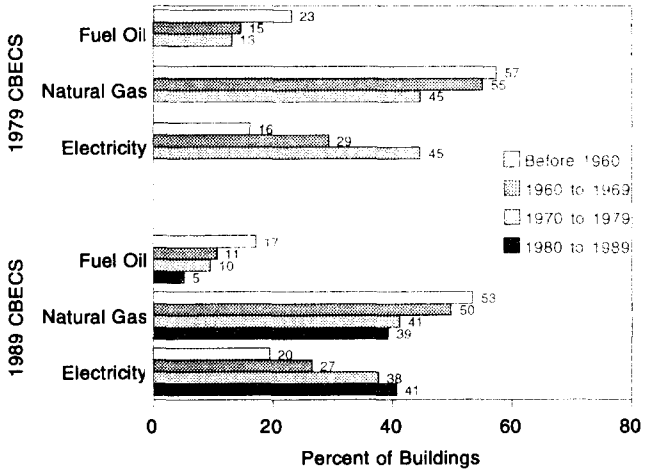
Figure 1.12. Percent of Buildings Using Major Energy Sources for Space Heating by Year Constructed

- The proportions of buildings that used electricity for space heat consistently increased from the earliest to the most recent period of construction for both residential and commercial buildings (Figures 1.12a and b).
- During the 1970's, electricity was increasingly selected for space heating in new construction, and by the beginning of the 1980's, it had risen almost to the level of natural gas use.
- The proportion of buildings using natural gas or fuel oil consistently declined from the earliest to the most recent periods of construction. That pattern held for the consumption surveys at the beginning of the decade and at the end (Figures 1.12a and b).
- The decline in the use of fuel oil for space heating mirrored its decline in use for any end uses, as well as the decline in total fuel oil consumption.

a. Residential Buildings, 1980 and 1990



b. Commercial Buildings, 1979 and 1989

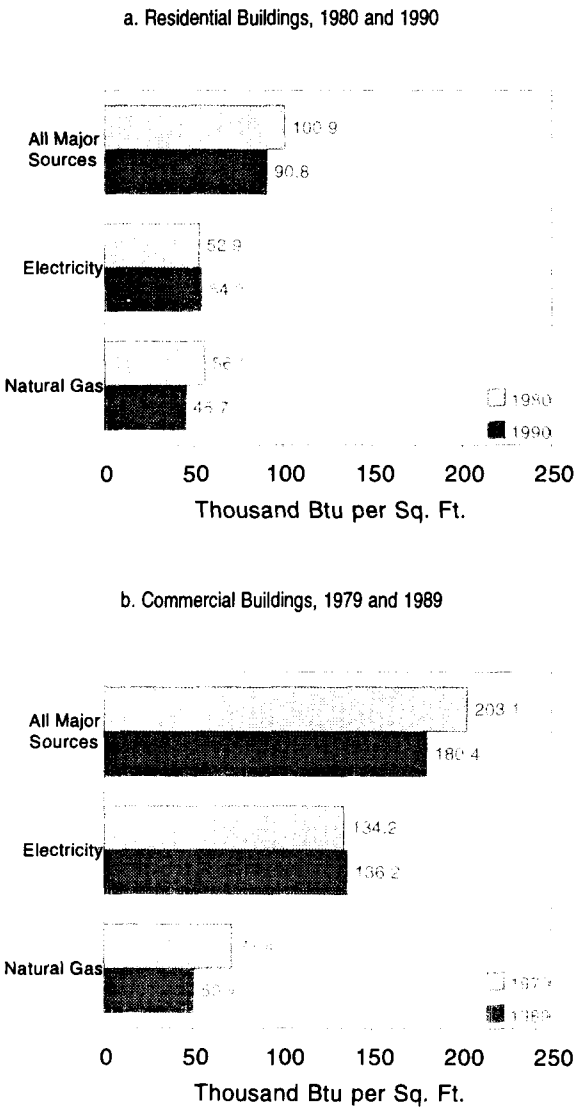


Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1980 and 1990 Residential Energy Consumption Surveys; Form EIA-143 of the 1979 Nonresidential Buildings Energy Consumption Survey, and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

Trends in Energy Intensity

Total energy intensity, measured as the ratio of energy consumed to floorspace (thousand Btu per square foot of floorspace that used a particular energy source), was greater in commercial buildings than in residential buildings throughout the 1980's (Figures 1.13a and b). This reflected differences in the uses of energy and the degree of building occupancy in the two sectors. Several major commercial building types exceeded 300 thousand Btu per square foot throughout the 1980's, whereas residential buildings were dominated by single-family detached homes that had intensities less than 100 thousand Btu per square foot during the decade.

Figure 1.13. Energy Intensities by Energy Source*



*All major energy sources and electricity intensities are based on primary electricity consumption. Intensities are not adjusted for the effect of weather.

Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1980 and 1990 Residential Energy Consumption Surveys; Form EIA-143 of the 1979 Nonresidential Buildings Energy Consumption Survey, and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

Electricity

- Electricity intensities were stable in both sectors during the decade, but the commercial intensity was more than twice as large as residential intensity (Figures 1.13a and b).

Natural Gas

- Natural gas intensities were greater in commercial buildings than in residential buildings at the beginning of the 1980's but, by the end of the decade, the intensities were not significantly different. Natural gas intensities in both groups decreased during the decade (Figures 1.13a and b).

Trends in Expenditures

Total expenditures for energy in residential buildings, in real terms (1987 dollars), exceeded energy expenditures in commercial buildings during the 1980's. At the end of the decade commercial expenditures were only 67 percent of residential expenditures (Figures 1.14a and b).

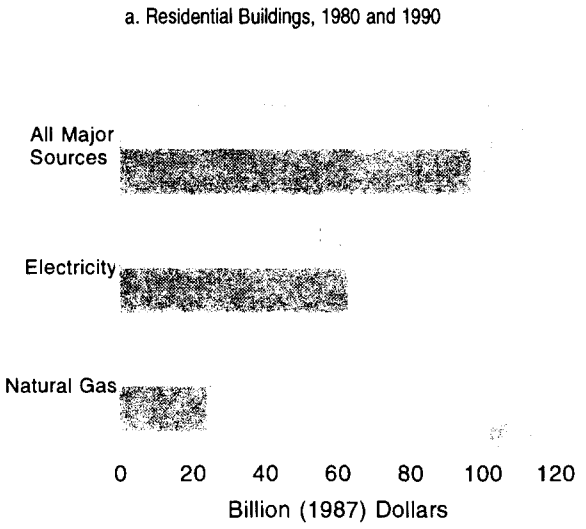
Electricity

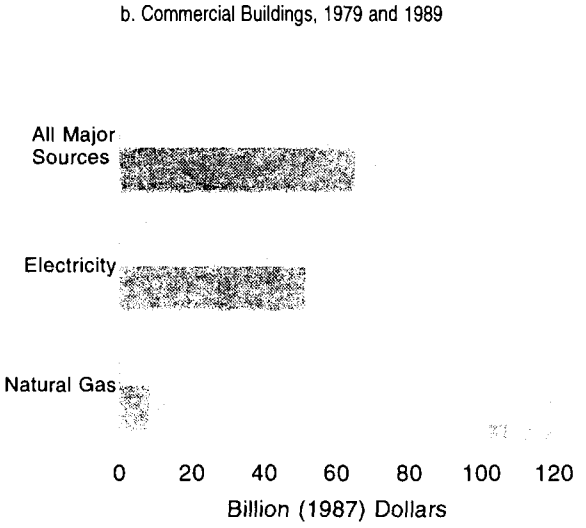
- Electricity expenditures in both sectors increased throughout the decade and exceeded those of other energy sources. Residential expenditures for electricity increased from 54 percent of total energy expenditures in 1980 to 65 percent in 1990, while in the commercial sector expenditures for electricity increased from 71 percent of total energy expenditures in 1979 to 79 percent in 1989 (Figures 1.14a and b).

Natural Gas

- In both sectors, natural gas expenditures were at about the same level at the beginning and end of the decade. By the end of the 1980's, natural gas expenditures were one-fourth of total expenditures in the residential sector and only one-eighth of the total in the commercial sector (Figures 1.14a and b).

Figure 1.14. Expenditures (1987 Dollars) for Energy by Energy Source*

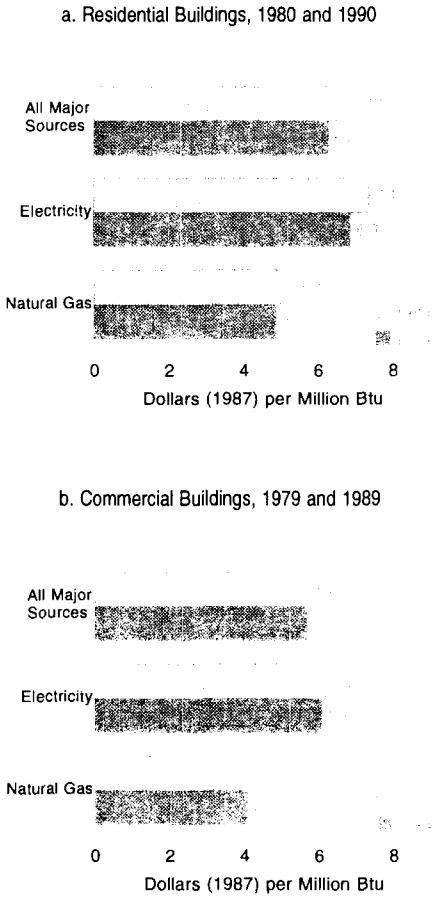




*See Appendix C, "Data Quality", for adjustment to 1987 dollars.

Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1980 and 1990 Residential Energy Consumption Surveys; Form EIA-143 of the 1979 Nonresidential Buildings Energy Consumption Survey, and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

Figure 1.15. Expenditure Intensities by Energy Source



Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1980 and 1990 Residential Energy Consumption Surveys; Form EIA-143 of the 1979 Nonresidential Buildings Energy Consumption Survey, and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

Figure 1.16. Expenditures (1987 Dollars) for End Uses in Residential Buildings in the 1980's

Sources: Energy Information Administration, Office of Energy Markets and End Use, Forms EIA-457 of the 1980, 1981, 1982, 1984, 1987, and 1990 Residential Energy Consumption Surveys.

Expenditure Intensities

- Expenditure intensities (dollars expended per million Btu of energy consumed) declined during the decade in the residential sector and remained constant in the commercial sector (Figures 1.15a and b).
- At the beginning of the decade, commercial expenditure intensity was 80 percent of residential, by the end of the decade, commercial expenditure intensity was 90 percent of residential (Figures 1.15a and b).
- Electricity expenditure intensities were greater than those of natural gas in both sectors throughout the 1980's.

Expenditures for End Uses

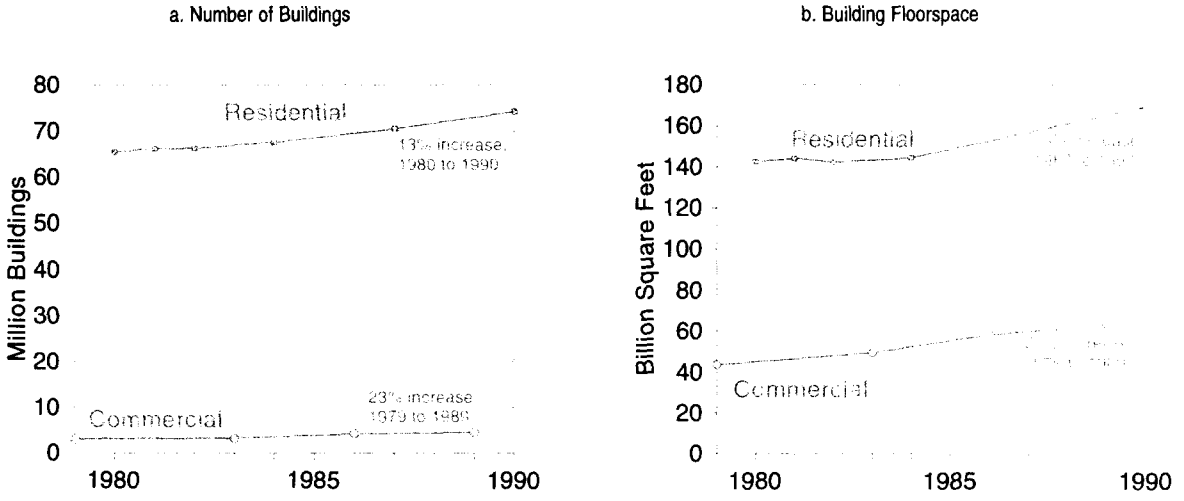
- In the residential sector, expenditures for space heating and appliances far exceeded those for water heating and air conditioning. From 1980 to 1982, expenditures for space heating and appliances were nearly identical. They subsequently diverged as space heating expenditures declined, while expenditures for appliances rose (Figure 1.16).
- The largest single contributor to the household energy bill is now the appliance load (Figure 1.16).

2. Characteristics of Buildings in the 1980's

By the end of the 1980's, there were more than 78 million buildings and 230 billion square feet of floorspace in the residential and commercial sectors in the United States. During the 1980's, the number of residential buildings increased by 13 percent to 74.2 million (about 95 percent of the total) and the number of commercial buildings increased 23 percent to 4.5 million (Figure 2.1a). Residential floorspace increased 19 percent to nearly 170 billion square feet (about 74 percent of the total), while commercial floorspace increased 26 percent to 63 billion square feet (Figure 2.1b).[4] The increase in the number of buildings and floorspace in these two sectors contrasts with the total population growth in the United States of only 9.8 percent, from 1980 to 1990 (Figure 2.2).

The population of residential and commercial buildings can be characterized in several ways, each of which has a bearing on the use and consumption of energy. Important categories are: type of building, average size of building, location of buildings, and year of construction.

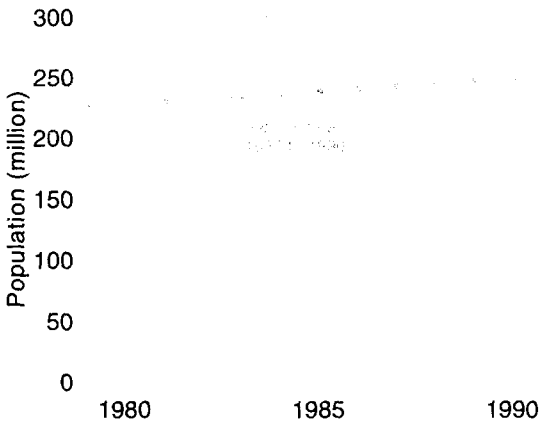
Figure 2.1. Number and Size of Residential and Commercial Buildings in the 1980's



Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1980 and 1990 Residential Energy Consumption Surveys.

[4]See Appendix C, "Data Quality", for adjustment of 1979 commercial buildings undercount.

Figure 2.2. United States Population in the 1980's



Sources: U.S. Bureau of the Census, *Statistical Abstract of the United States: 1993* (113th edition, Washington, DC, 1993).

Buildings and Floorspace by Type of Building

Throughout the 1980's, the single-family detached home was, by far, the predominant type of building and occupied the most floorspace in both the residential and commercial sectors (Figures 1.3 and 1.4). By the end of the 1980's:

- Single-family detached homes accounted for nearly three-fourths of all buildings and more than half of total floorspace.

- Commercial buildings accounted for only six percent of buildings but slightly more than one-fourth of total floorspace because of the greater average size of commercial buildings.

The number of residential buildings increased 13 percent during the decade, while their floorspace increased 19 percent. The number of commercial buildings increased 23 percent, with a 26 percent increase in floorspace.

- Two types of residential buildings, single-family attached and the larger apartment buildings (five or more units), increased their numbers much more rapidly than average. The growth in the former is due to the increased popularity of condominiums and townhouses. Small apartment buildings (2 to 4 units) showed no growth in number of buildings but did increase in floorspace on average (Figures 2.3a and b).

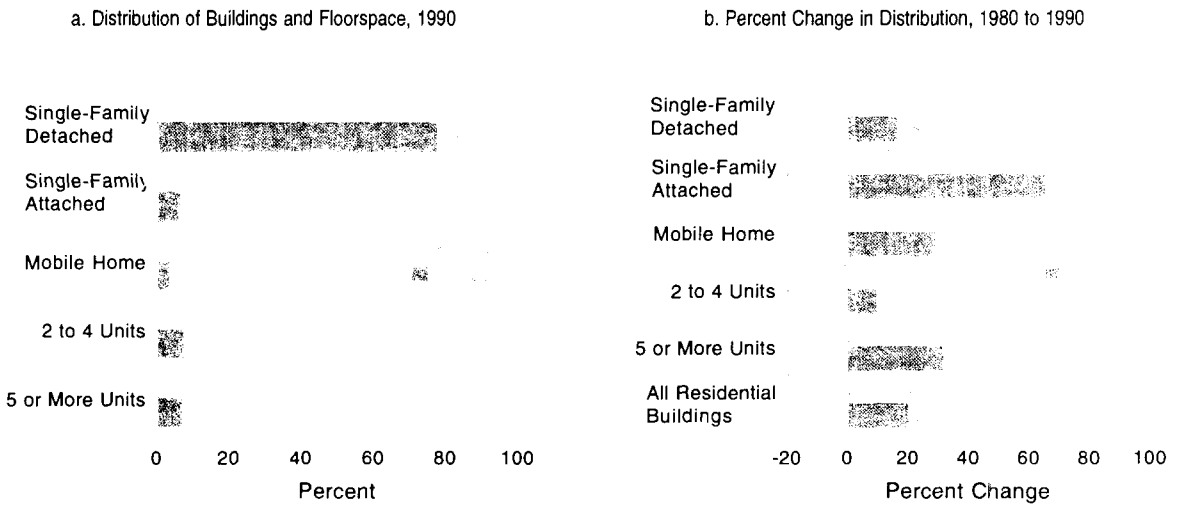
- In the commercial sector, offices and warehouses increased more in number of buildings and floorspace than average, while assembly, education, and health care buildings grew less than average in both number of buildings and floorspace (Figures 2.4a and b).

Residential and commercial buildings increased in average floorspace--from 2,176 to 2,280 square feet (an increase of 4.8 percent) for residential and from 13,637 to 13,954 square feet (an increase of 2.3 percent) for commercial.

- Floorspace in residential multi-unit buildings (small and large) and in mobile homes increased more than the average for residential buildings. Only single-family attached homes showed a decrease in average floorspace (Figures 2.5a and b).

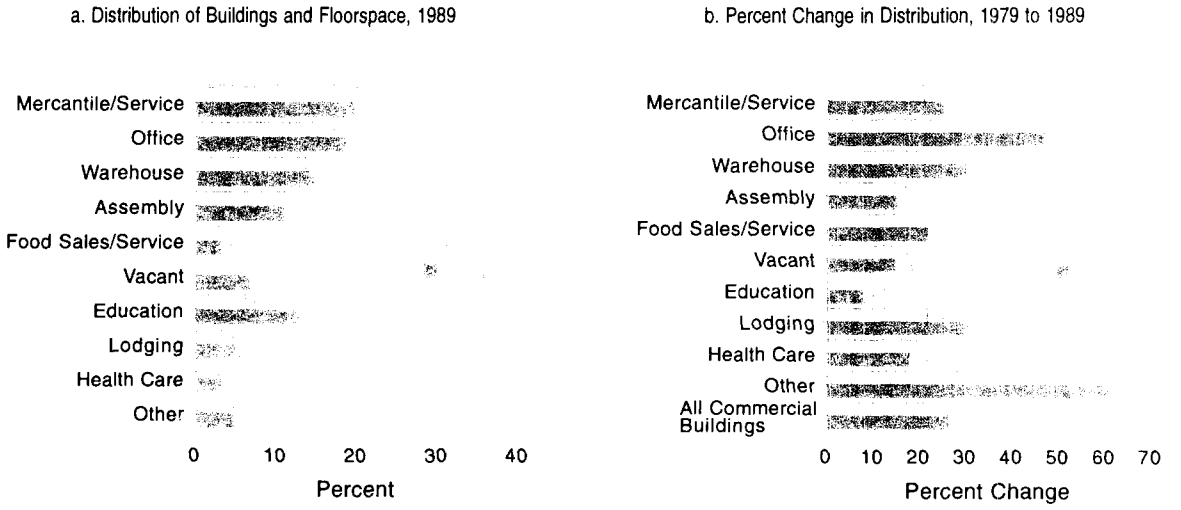
- In the commercial sector, floorspace in office and lodging buildings increased more than the average floorspace for commercial buildings overall. Education and food sales and service buildings showed a significant decrease in floorspace. The latter phenomenon possibly reflects the trend toward fast food restaurants (Figures 2.6a and b).

Figure 2.3. Distribution of Residential Buildings and Floorspace by Type



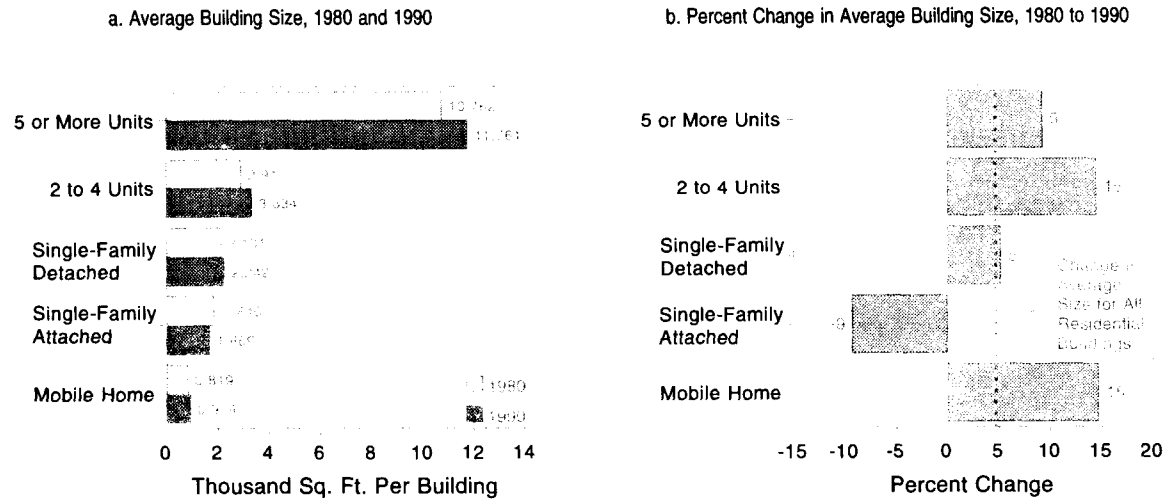
Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1980 and 1990 Residential Energy Consumption Surveys.

Figure 2.4. Distribution of Commercial Buildings and Floorspace by Type



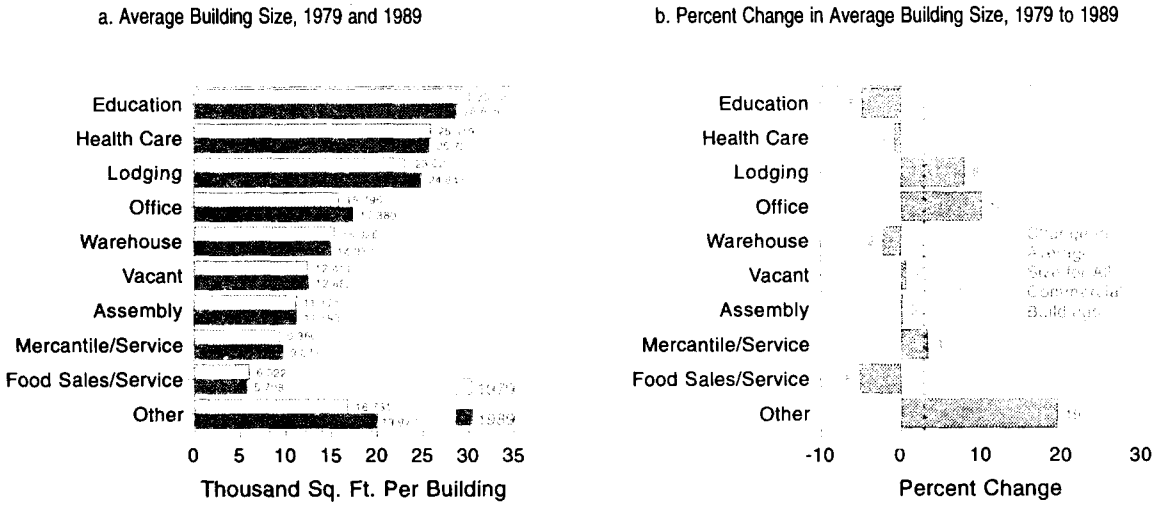
Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-143 of the 1979 Nonresidential Buildings Energy Consumption Survey and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

Figure 2.5. Average Size of Residential Buildings by Type



Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1980 and 1990 Residential Energy Consumption Surveys.

Figure 2.6. Average Size of Commercial Buildings by Type



Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-143 of the 1979 Nonresidential Buildings Energy Consumption Survey and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

Buildings in Various Size Categories

During the 1980's, the proportion of residential and commercial buildings in the various size categories remained approximately the same. Residential buildings were clustered in the three smallest categories, while commercial buildings were spread over a much larger range of sizes (Figures 2.7a and 2.8a). The average size of *all* residential buildings increased 4.8 percent between 1980 and 1990 (from 2,176 to 2,280 square feet per building). This change largely reflected the 5.2 percent increase in the average floorspace of single-family detached homes (from 2,131 to 2,242 square feet).

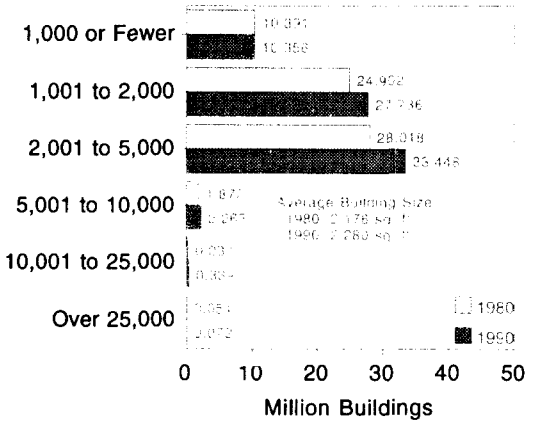
During the 1980's:

- The greatest growth in the number of residential buildings occurred in the categories of building size greater than 2,000 square feet. This growth was consistent with the increase in average size of single-family detached and apartment buildings. The greatest number of buildings added was in the 2,001 to 5,000 square feet category (Figure 2.7a and b).

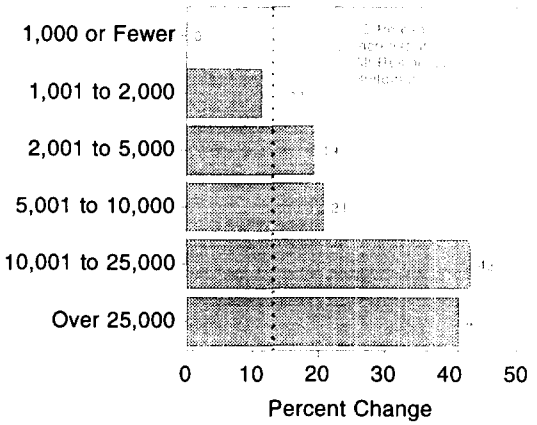
- Commercial buildings showed remarkably similar growth in number of buildings across all size categories. Almost all were within a few percentage points of the commercial average of 23 percent, with the exception of the largest category (Figure 2.8b).

Figure 2.7. Number of Residential Buildings by Size

a. Number of Buildings, 1980 and 1990

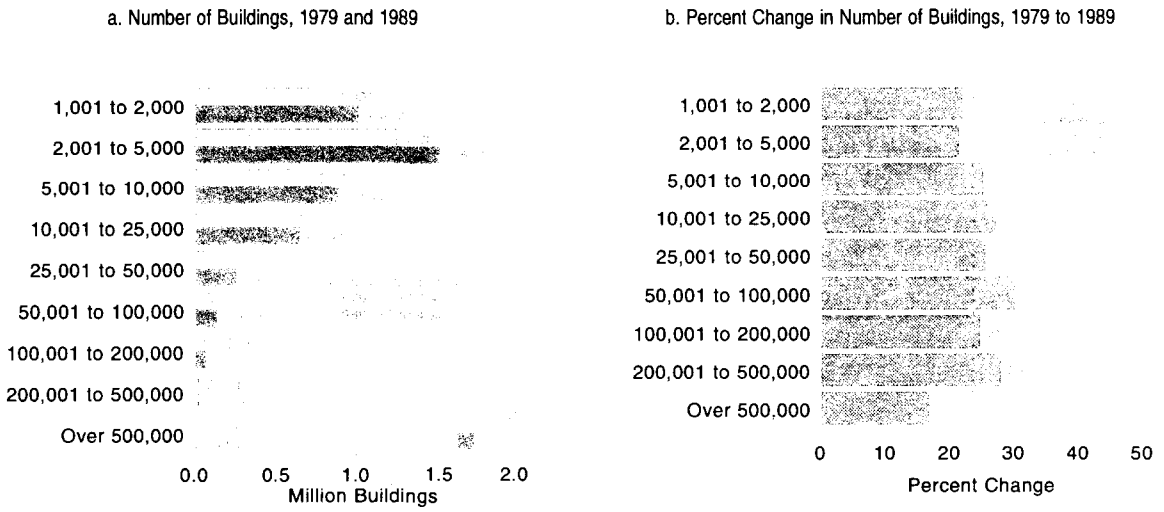


b. Percent Change in Number of Buildings, 1980 to 1990



Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1980 and 1990 Residential Energy Consumption Surveys.

Figure 2.8. Number of Commercial Buildings by Size



Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-143 of the 1979 Nonresidential Buildings Energy Consumption Survey and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

Buildings and Floorspace by Census Region

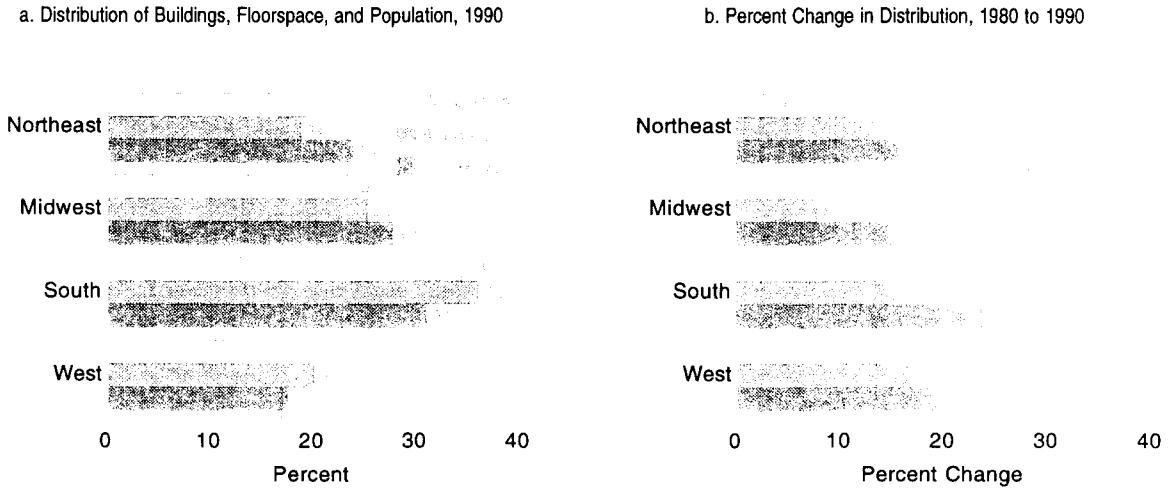
Not surprisingly, the residential building distribution by Census region was similar to the population distribution. However, the distribution of floorspace differed by region--buildings were largest in the Northeast (due to more large apartment buildings) and smallest in the South (due to fewer large apartment buildings) (Figure 2.9a).

- The increase in the number of buildings and the amount of floorspace in both sectors exceeded population growth in all regions except in the West. In the Midwest and South, the increase in floorspace was greater than the increase in the number of buildings, i.e., the average building size increased (Figure 2.9b).

- The distribution of commercial buildings mirrored the 1989 population distribution fairly closely, although in the Northeast the proportion of buildings was less, and in the South the proportion of floorspace was less. As with residential buildings, commercial buildings tended to be larger in the Northeast and smaller in the South (Figure 2.10a).

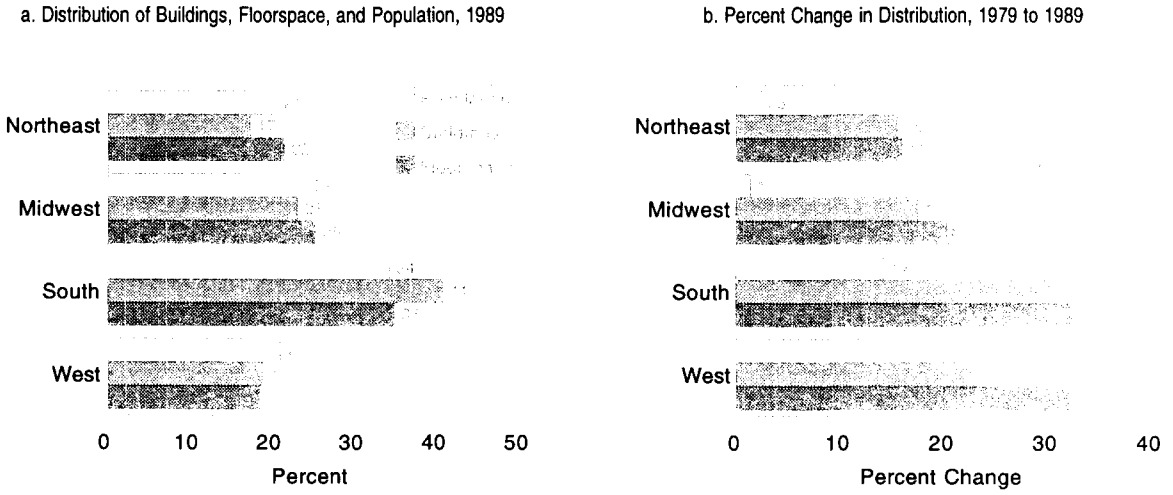
- In commercial buildings the percent change in both the number of buildings and floorspace exceeded the percent change in population in all regions, although in the West the percent change in the number of buildings was very close to the change in population. This is consistent with the increase in average size there (Figure 2.10b).

Figure 2.9. Distribution of Residential Buildings, Floorspace, and U.S. Population by Census Region



Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1980 and 1990 Residential Energy Consumption Surveys.

Figure 2.10. Distribution of Commercial Buildings, Floorspace, and U.S. Population by Census Region



Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-143 of the 1979 Nonresidential Buildings Energy Consumption Survey and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

Buildings and Floorspace by Year Constructed

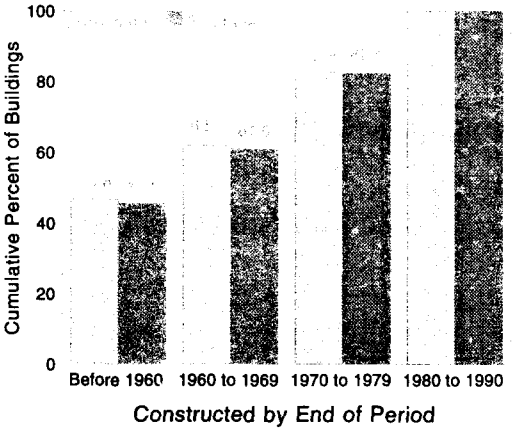
Because the number of buildings is so large, the addition of new buildings and floorspace over a decade has limited impact on the building stock.

- Buildings constructed during the 1980's accounted for only about 17 percent of the stock of residential buildings and their floorspace. At the end of the decade, nearly half of the buildings and floorspace were constructed before 1960 (Figure 2.11a).

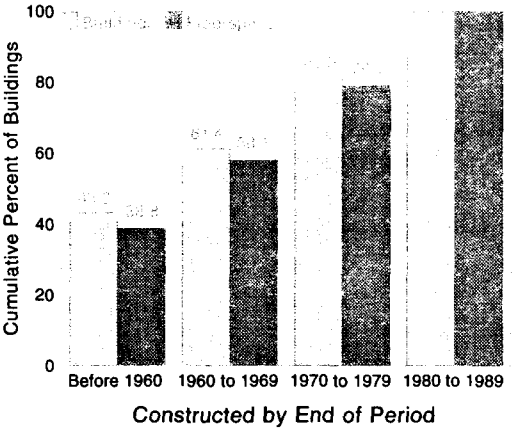
- In the commercial sector, 19 percent of buildings and 21 percent of floorspace were added between 1979 and 1989. Forty-three percent of commercial buildings (and 39 percent of floorspace) were constructed before 1960 (Figure 2.11b).

Figure 2.11. Distribution of Buildings and Floorspace by Year Constructed

a. Cumulative Percent of Residential Buildings and Floorspace, 1990



b. Cumulative Percent of Commercial Buildings and Floorspace, 1989



Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1990 Residential Energy Consumption Survey, and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

Table 2.1. Number and Total Floorspace of Residential and Commercial Buildings

Year of Survey	Residential Buildings		Commercial Buildings		
	Number of Buildings (thousand)	Total Floorspace (million sq. ft.)	Number of Buildings (thousand)	Total Floorspace (million sq. ft.)	
RSE Column Factors:	1.0	1.1	1.0	1.0	RSE Row Factors
1979	--	--	3,073	43,546	5.8
1980	65,471	142,495	--	--	1.2
1981	66,210	144,201	--	--	1.3
1982	66,210	142,247	--	--	1.2
1983	--	--	3,185	49,471	5.8
1984	67,576	144,357	--	--	1.2
1985	--	--	--	--	--
1986	--	--	4,154	58,199	3.2
1987	70,446	156,818			1.2
1988	--	--	--	--	--
1989	--	--	4,528	63,184	3.2
1990	74,213	169,227	--	--	1.4

Notes: • To obtain the Relative Standard Error (RSE) percentage for any table cell, multiply the corresponding RSE column factor by the corresponding RSE row factor for the cell. • See "Glossary" for definition of terms used in this report.

Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1980, 1981, 1982, 1984, 1987, and 1990 Residential Energy Consumption Surveys; Forms EIA-143, 788, and 871 of the 1979, 1983, and 1986 Nonresidential Buildings Energy Consumption Surveys; and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

Table 2.2 Number of Residential Buildings and Total Floorspace, 1980 and 1990

Building Characteristics	Number of Buildings (thousand)		Floorspace (million square feet)		RSE Row Factors
	1980	1990	1980	1990	
RSE Column Factors:	0.7	0.7	0.7	0.8	
All Buildings	65,471	74,213	142,495	169,227	2.1
Census Region					
Northeast	12,287	13,903	34,849	40,345	4.0
Midwest	17,388	18,738	40,796	46,939	3.8
South	23,105	26,735	42,182	52,440	4.0
West	12,691	14,837	24,668	29,503	4.3
Census Division					
New England	2,927	3,162	8,860	9,294	9.1
Middle Atlantic	9,360	10,741	25,988	31,051	4.9
East North Central	11,835	13,306	27,793	33,757	5.2
West North Central	5,552	5,433	13,003	13,181	7.2
South Atlantic	11,812	13,403	22,288	26,612	6.5
East South Central	4,567	5,436	8,557	10,770	11.8
West South Central	6,726	7,896	11,337	15,057	7.7
Mountain	3,507	4,167	6,338	7,818	9.8
Pacific	9,183	10,670	18,330	21,685	6.3
Type of Home					
Mobile Home	4,646	5,212	3,804	4,895	12.2
Single-Family Detached	52,992	58,363	112,941	130,855	3.1
Single-Family Attached	3,300	6,001	6,071	10,014	18.1
2 to 4 Units	3,707	3,644	10,790	11,784	10.7
5 or More Units	826	993	8,889	11,679	11.3
Building Floorspace (square feet)					
Fewer than 1,001	10,391	10,356	7,791	8,297	6.6
1,001 to 2,000	24,902	27,736	37,212	41,190	4.4
2,001 to 5,000	28,018	33,448	79,248	96,277	4.0
5,001 to 10,000	1,872	2,263	11,789	14,465	13.3
10,001 to 25,000	237	339	3,288	4,441	22.8
25,001 to 50,000	31	34	1,046	1,135	25.7
50,001 to 100,000	14	29	910	1,930	34.5
100,001 to 200,000	5	7	767	820	46.5
Over 200,000	2	2	445	673	39.7
Year Constructed					
1939 or Before	18,382	16,760	43,283	40,769	5.7
1940 to 1949	6,173	6,069	11,861	11,592	9.1
1950 to 1959	12,347	11,883	23,703	24,694	7.1
1960 to 1969	12,086	11,356	26,207	26,191	7.0
1970 to 1979	15,280	15,329	34,323	36,274	6.3
1980 to 1990	1,204	12,815	3,119	29,708	12.9

Notes: • To obtain the Relative Standard Error (RSE) percentage for any table cell, multiply the corresponding RSE column factor by the corresponding RSE row factor for the cell. • Because of rounding, data may not sum to totals. • See "Glossary" for definition of terms used in this report.

Source: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1980 and 1990 Residential Energy Consumption Surveys.

Table 2.3. Number of Commercial Buildings and Total Floorspace, 1979 and 1989

Building Characteristics	Number of Buildings (thousand)			Floorspace (million square feet)			RSE Row Factors
	1979	1979 (adjusted)*	1989	1979	1979 (adjusted)	1989	
RSE Column Factors:	1.1	NF	0.8	1.1	NF	0.9	
All Buildings	3,073	3,667	4,528	43,546	50,004	63,184	4.3
Census Region							
Northeast	530	677	783	9,531	11,688	13,569	9.8
Midwest	977	889	1,046	14,197	13,144	15,955	8.5
South	1,094	1,411	1,847	13,661	16,548	22,039	8.2
West	472	690	851	6,156	8,624	11,620	9.6
Principal Building Activity							
Assembly	425	538	617	5,329	6,006	6,909	9.7
Education	158	248	282	5,969	7,482	8,076	9.6
Food Sales and Service	317	267	343	1,770	1,609	1,958	8.9
Health Care	50	67	80	1,955	1,744	2,054	15.7
Lodging	97	115	140	2,074	2,658	3,476	11.4
Mercantile and Service	968	1,056	1,278	9,959	9,879	12,365	6.4
Office	455	508	679	6,986	8,017	11,802	7.2
Warehouse	367	459	618	6,007	7,039	9,253	7.9
Other	115	116	157	2,129	1,940	3,129	12.8
Vacant	122	292	333	1,367	3,630	4,161	15.1
Building Floorspace (square feet)							
1,001 to 2,000	532	830	1,012	786	1,252	1,535	7.6
2,001 to 5,000	1,000	1,251	1,517	3,356	4,360	5,254	5.0
5,001 to 10,000	706	712	890	5,073	5,226	6,532	6.3
10,001 to 25,000	486	507	644	7,665	8,107	10,393	7.2
25,001 to 50,000	193	197	247	6,780	7,025	8,801	7.3
50,001 to 100,000	94	98	127	6,449	7,043	9,130	8.6
100,001 to 200,000	41	49	61	5,558	6,733	8,277	9.3
200,001 to 500,000	17	18	23	5,169	5,520	7,022	12.7
Over 500,000	3	6	7	2,710	4,738	6,239	15.3
Year Constructed							
1899 or Before	168	172	172	1,999	1,654	1,654	14.5
1900 to 1919	327	242	242	4,660	4,245	4,245	11.1
1920 to 1945	625	680	680	8,660	8,098	8,098	8.1
1946 to 1959	686	868	868	8,391	10,511	10,511	7.7
1960 to 1969	592	821	821	9,360	12,617	12,167	6.9
1970 to 1979	675	884	884	10,478	13,329	13,329	7.0
1980 to 1989	--	--	861	--	--	13,180	6.9

*See Appendix C, "Data Quality", for adjustment of 1979 buildings and floorspace estimates to account for 1979 CBECS undercoverage.

Notes: • To obtain the Relative Standard Error (RSE) percentage for any table cell, multiply the corresponding RSE column factor by the corresponding RSE row factor for the cell. • Because of rounding, data may not sum to totals. • See "Glossary" for definition of terms used in this report.

Source: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-143 of the 1979 Nonresidential Buildings Energy Consumption Survey and Form EIA-871 the 1989 Commercial Buildings Energy Consumption Survey.

3. Energy Sources and End Uses

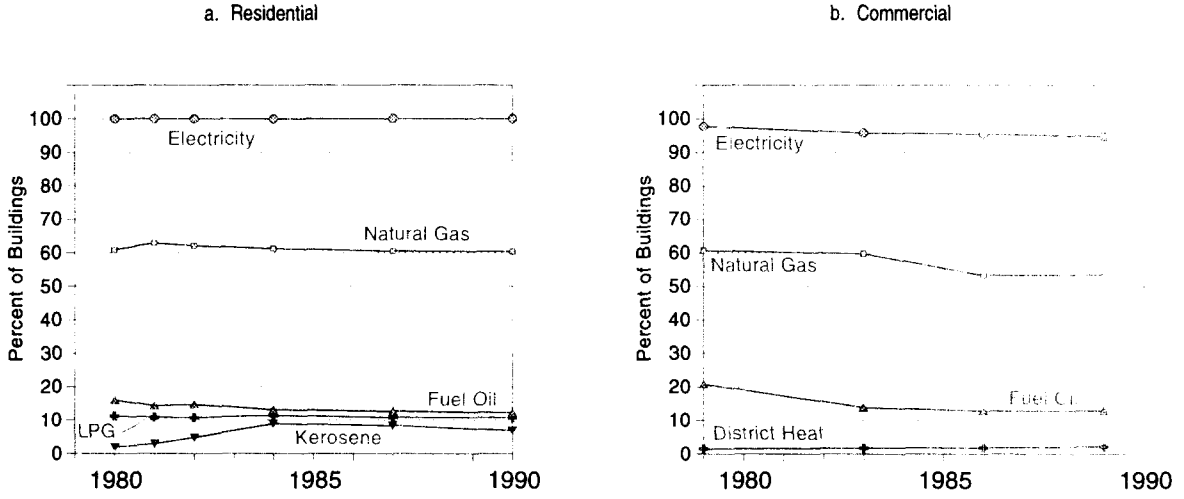
Energy is an important but often unnoticed contributor to the high levels of productivity and quality of life enjoyed by U.S. residents. Energy is used in buildings to provide heating, cooling, lighting, and other services to the building occupants. Throughout the 1980's, the two energy sources that were most widely used in the residential and commercial sectors were electricity and natural gas. The former was used almost universally, while the latter was used in more than half of both residential and commercial buildings. Other energy sources, such as fuel oil and district heat, were used in fewer than 21 percent of buildings (Figure 3.1a and b).

The major purposes for which energy was used in residential and commercial buildings were for space heating, water heating, air conditioning, lighting, and appliances. Electricity, the most versatile, was used for all these end uses. The other major sources of energy were most often used for space heating. Fuel oil was used predominantly in the Northeast Census region.

In residential and commercial buildings throughout the 1980's:

- The percentages of buildings that used electricity and natural gas remained approximately constant.
- The percentage of buildings using fuel oil declined.
- Liquefied petroleum gas (LPG) use in residential buildings was constant at just over 10 percent of buildings, while use of district heat in commercial buildings was constant at two percent.
- Kerosene use in residential buildings increased (due to the increased popularity of portable space heaters).

Figure 3.1. Percent of Buildings Using Major Energy Sources for Any Purpose in the 1980's



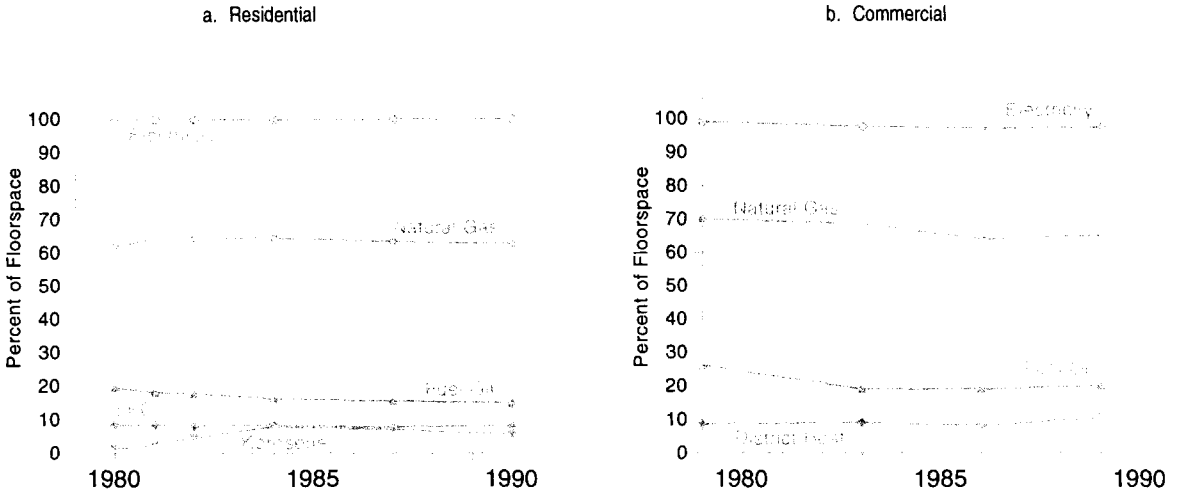
Sources: Energy Information Administration, Office of Energy Markets and End Use, Forms EIA-457 of the 1980, 1981, 1982, 1984, 1987, and 1990 Residential Energy Consumption Surveys; Forms EIA-143, 788, and 871 of the 1979, 1983, and 1986 Nonresidential Buildings Energy Consumption Surveys; and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

The choice of energy sources is related to average building floorspace, one of the major differences between the residential and commercial sectors.

- In the commercial sector, natural gas, fuel oil, and district heat were supplied to a greater proportion of floorspace than the proportion of buildings, reflecting their greater use in larger buildings. In the residential sector, the use of energy sources by number of buildings was virtually identical to the percent of floorspace that used the same energy sources.

- The use of district heat provides a striking example of the effect of building size. In commercial buildings, district heat was used in just two percent of the buildings, but these buildings accounted for ten percent of the floorspace. In 1989, 50 percent of the commercial buildings (representing 54 percent of total commercial floorspace) that used district heat were buildings larger than 200,000 square feet, while fewer than eight percent of commercial buildings smaller than 25,000 used district heat.

Figure 3.2. Percent of Floorspace Using Major Energy Sources for Any Purpose in the 1980's



Sources: Energy Information Administration, Office of Energy Markets and End Use, Forms EIA-457 of the 1980, 1981, 1982, 1984, 1987, and 1990 Residential Energy Consumption Surveys; Forms EIA-143, 788, and 871 of the 1979, 1983, and 1986 Nonresidential Buildings Energy Consumption Surveys; and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

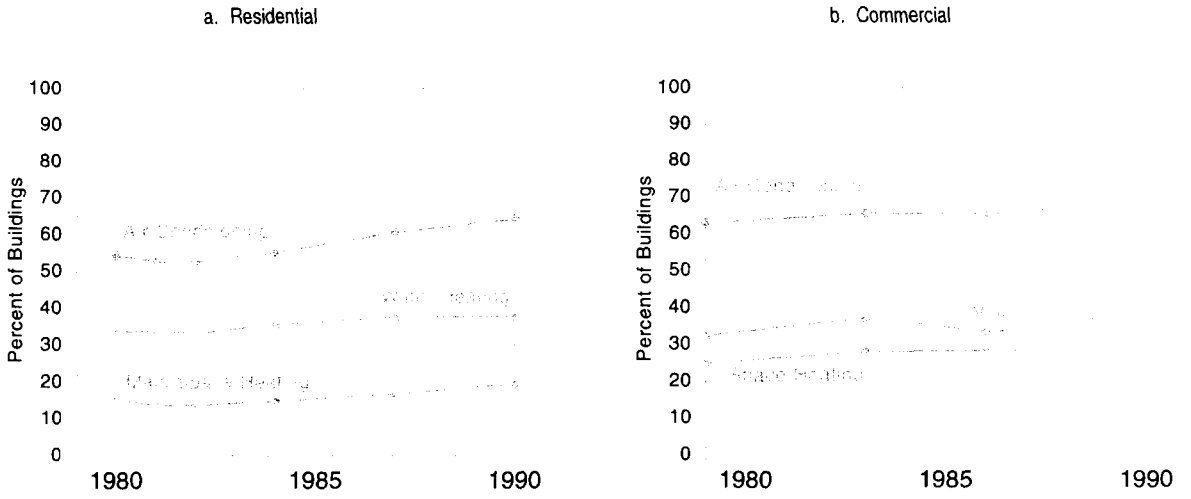
Energy Sources Used for Major End Uses

The energy sources used for the major end uses (space heating, water heating, and air conditioning) varied according to the end use employed. Natural gas was the energy source of choice for space heating in both sectors. Natural gas was the first choice for water heating in residential buildings.[5] Residential and commercial buildings were primarily cooled by electricity. Fuel oil was used in fewer than 13 percent of buildings for space heating and in fewer than five percent for water heating.

The percentage of buildings that used natural gas, electricity, or fuel oil for specific end uses changed little during the 1980's (Figures 3.3a and b, and 3.4a and b). Notable exceptions included the more widespread use of electricity for main space heating and an increase in air conditioning in residential buildings to more than 60 percent by the end of the decade (the latter reflected the increasing popularity of central air conditioning systems).

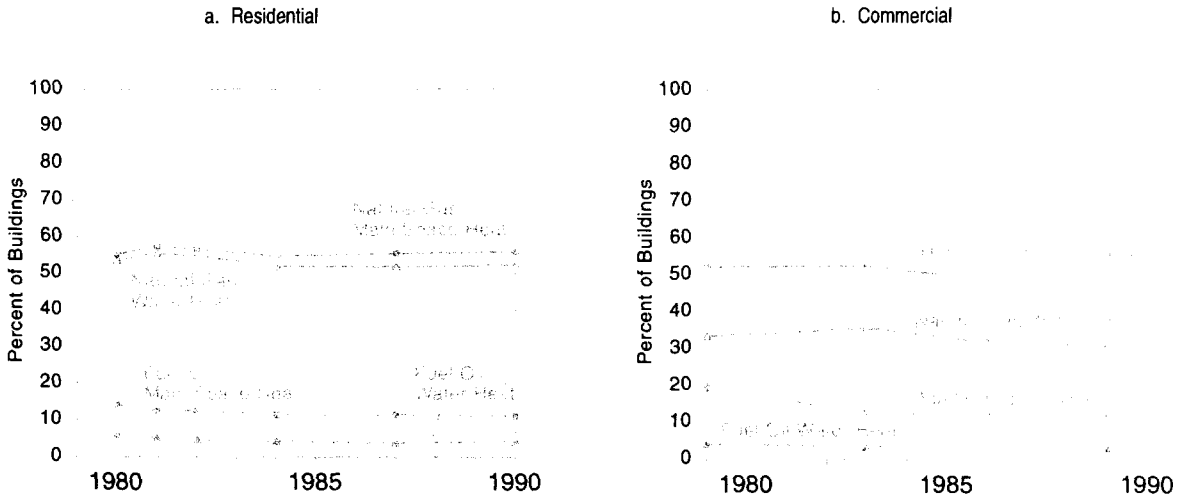
[5]Space heating use in commercial buildings included both main (i.e., most used) and secondary uses.

Figure 3.3. Use of Electricity for Space Heating, Air Conditioning, and Water Heating in Residential and Commercial Buildings in the 1980's



Sources: Energy Information Administration, Office of Energy Markets and End Use, Forms EIA-457 of the 1980, 1981, 1982, 1984, 1987, and 1990 Residential Energy Consumption Surveys; Forms EIA-143, 788, and 871 of the 1979, 1983, and 1986 Nonresidential Buildings Energy Consumption Surveys; and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

Figure 3.4. Use of Natural Gas and Fuel Oil for Space Heating and Water Heating in Residential and Commercial Buildings in the 1980's



Sources: Energy Information Administration, Office of Energy Markets and End Use, Forms EIA-457 of the 1980, 1981, 1982, 1984, 1987, and 1990 Residential Energy Consumption Surveys; Forms EIA-143, 788, and 871 of the 1979, 1983, and 1986 Nonresidential Buildings Energy Consumption Surveys; and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

Energy Sources Used for Space Heating

Natural gas, electricity, and fuel oil were the major energy sources used for space heating, the end use that accounted for the largest share of energy consumption in both residential and commercial buildings (Figures 3.5a and b):

- Natural gas was the most popular energy source used for space heating in residential and commercial buildings.
- Electricity and fuel oil were used for main space heating in 15 percent of residential buildings at the beginning of the decade, with electricity rising to 20 percent and fuel oil falling to 10 percent by the end of the decade.
- During the 1980's, electricity was used in the commercial sector for space heating in 25 percent to 30 percent of the buildings; fuel oil was used in 10 to 20 percent of the buildings; and district heat was used in fewer than 5 percent of the buildings.

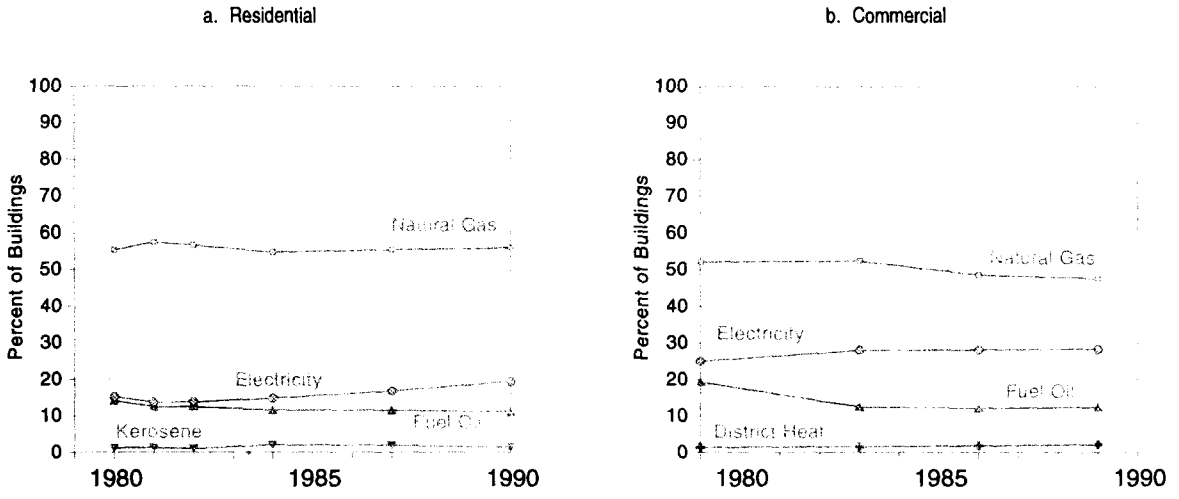
The proportion of natural gas, electricity, and fuel oil used for space heating varied by the age of the buildings and by Census region, but this proportion remained about the same throughout the decade. The use of natural gas, electricity, or fuel oil varied in the building stock by year of construction (Figures 3.6a and b):

- The newer the building, the more likely it was to use electricity.
- The older the building, the more likely it was to use natural gas or fuel oil.

Each of the Census regions used the three major energy sources in different proportions (Figures 3.7a and b):

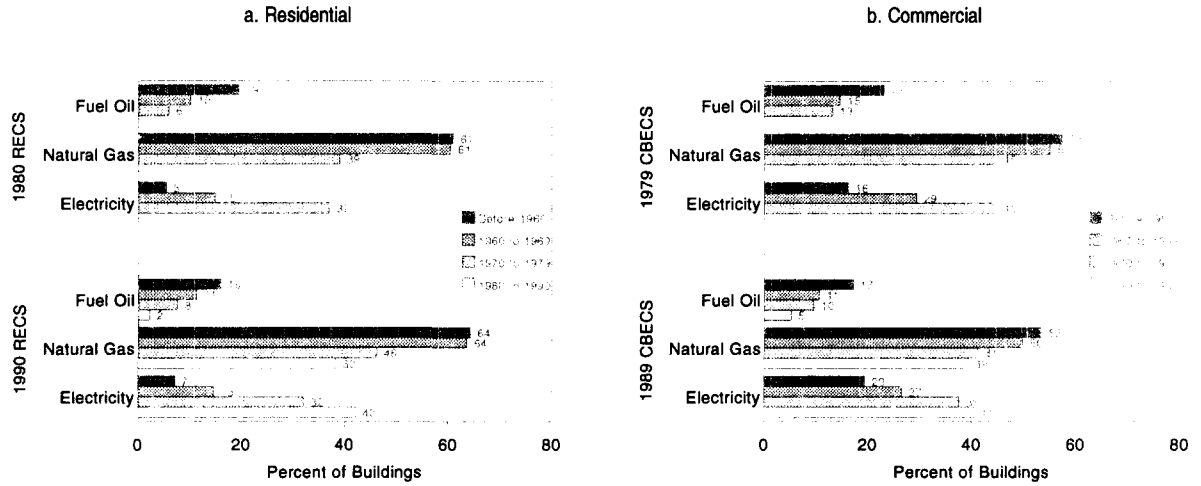
- The Northeast had by far the largest proportion of buildings using fuel oil.
- The proportion of buildings using natural gas was highest in the Midwest and West.
- The proportion of buildings in the South and West using electricity was two to three times higher than the proportion in the Northeast and Midwest.

Figure 3.5. Energy Sources Used for Space Heating in Buildings in the 1980's



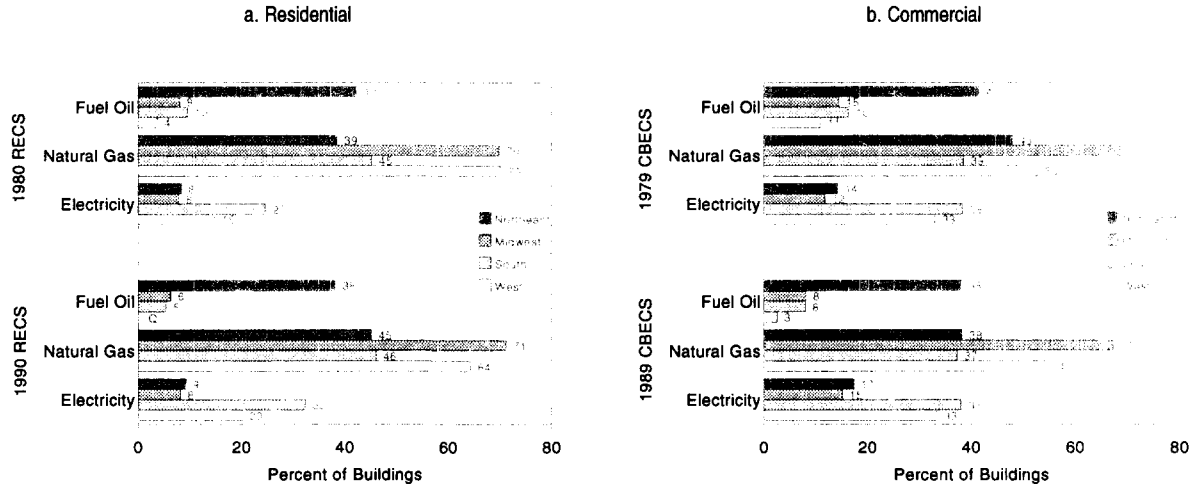
Sources: Energy Information Administration, Office of Energy Markets and End Use, Forms EIA-457 of the 1980, 1981, 1982, 1984, 1987, and 1990 Residential Energy Consumption Surveys; Forms EIA-143, 788, and 871 of the 1979, 1983, and 1986 Nonresidential Buildings Energy Consumption Surveys; and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

Figure 3.6. Energy Sources Used for Space Heating in Buildings by Age of Building



Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1980 and 1990 Residential Energy Consumption Surveys; Form EIA-143 of the 1979 Nonresidential Buildings Energy Consumption Survey, and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

Figure 3.7. Energy Sources Used for Space Heating in Buildings by Census Region



Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1980 and 1990 Residential Energy Consumption Surveys; Form EIA-143 of the 1979 Nonresidential Buildings Energy Consumption Survey, and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

Table 3.1a. Energy Sources Used for All End Uses in Residential Buildings, Number of Buildings and Total Floorspace

Year of Survey	Energy Sources												RSE Row Factors
	Any Energy Source		Electricity		Natural Gas		Fuel Oil		Kerosene		LPG		
	Buildings (thousand)	Floorspace (million sq. ft.)	Buildings (thousand)	Floorspace (million sq. ft.)	Buildings (thousand)	Floorspace (million sq. ft.)	Buildings (thousand)	Floorspace (million sq. ft.)	Buildings (thousand)	Floorspace (million sq. ft.)	Buildings (thousand)	Floorspace (million sq. ft.)	
RSE Column Factors:	0.3	0.4	0.3	0.4	0.8	0.9	1.7	1.6	2.6	2.7	2.5	2.5	
1980	65,471	142,495	65,440	142,480	39,838	88,521	10,506	27,996	1,293	1,983	7,380	12,146	4.3
1981	66,210	144,201	66,174	144,183	41,636	92,768	9,468	26,133	1,919	3,468	7,224	12,151	4.0
1982	66,210	142,247	66,169	142,220	41,111	91,847	9,711	25,293	3,200	6,534	7,171	11,730	4.2
1984	67,576	144,357	67,516	144,274	41,355	93,163	8,837	23,316	6,040	11,259	7,674	11,992	3.5
1987	70,446	156,818	70,424	156,780	42,599	99,357	8,948	24,360	5,918	10,939	7,610	12,286	3.8
1990	74,213	169,227	74,179	169,204	44,829	106,320	9,151	25,386	5,112	9,338	7,979	13,876	4.1

Notes: • To obtain the Relative Standard Error (RSE) percentage for any table cell, multiply the corresponding RSE column factor by the corresponding RSE row factor for the cell. • See "Glossary" for definition of terms used in this report.

Source: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1980, 1981, 1982, 1984, 1987, and 1990 Residential Energy Consumption Surveys.

Table 3.1b. Energy Sources Used for Main Space Heating in Residential Buildings, Number of Buildings and Total Floorspace

Year of Survey	Energy Sources												RSE Row Factors
	Any Energy Source		Electricity		Natural Gas		Fuel Oil		Kerosene		LPG		
	Buildings (thousand)	Floorspace (million sq. ft.)	Buildings (thousand)	Floorspace (million sq. ft.)	Buildings (thousand)	Floorspace (million sq. ft.)	Buildings (thousand)	Floorspace (million sq. ft.)	Buildings (thousand)	Floorspace (million sq. ft.)	Buildings (thousand)	Floorspace (million sq. ft.)	
RSE Column Factors:	0.2	0.2	1.3	1.1	0.6	0.6	1.1	1.0	3.5	3.2	3.0	2.0	
1980	65,046	141,964	9,999	22,086	36,293	78,242	9,299	25,084	769	811	3,544	5,152	6.2
1981	65,897	143,734	9,088	20,122	38,073	82,308	8,177	22,729	834	1,038	3,670	5,569	5.9
1982	65,879	141,809	9,125	19,370	37,528	81,429	8,289	21,611	689	900	3,735	5,440	6.9
1984	67,156	143,814	10,012	21,082	37,023	81,495	7,749	20,381	1,332	1,689	3,863	5,216	5.8
1987	69,831	155,839	11,869	26,888	39,075	88,895	8,096	22,060	1,259	1,453	4,141	6,286	6.3
1990	73,703	168,625	14,480	32,372	41,528	96,553	8,228	22,965	999	1,137	4,346	7,266	6.6

Notes: • To obtain the Relative Standard Error (RSE) percentage for any table cell, multiply the corresponding RSE column factor by the corresponding RSE row factor for the cell. • See "Glossary" for definition of terms used in this report.

Source: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1980, 1981, 1982, 1984, 1987, and 1990 Residential Energy Consumption Surveys.

Table 3.2a. Energy Sources Used for All End Uses in Commercial Buildings, Number of Buildings and Total Floorspace

Year of Survey	All Commercial Buildings		Energy Sources										RSE Row Factors
			Any Energy Source		Electricity		Natural Gas		Fuel Oil		District Heat		
	Buildings (thousand)	Floorspace (million sq. ft.)	Buildings (thousand)	Floorspace (million sq. ft.)	Buildings (thousand)	Floorspace (million sq. ft.)	Buildings (thousand)	Floorspace (million sq. ft.)	Buildings (thousand)	Floorspace (million sq. ft.)	Buildings (thousand)	Floorspace (million sq. ft.)	
RSE Column Factors:	0.7	0.7	0.7	0.7	0.7	0.7	0.9	0.9	1.6	1.2	2.6	2.4	
1979	3,073	43,546	3,014	43,220	3,001	43,153	1,864	30,477	641	11,397	47	3,722	8.2
1983	3,185	49,471	3,062	48,460	3,052	48,327	1,904	33,935	441	9,409	57	4,454	7.9
1986	4,154	58,199	3,994	56,835	3,965	56,508	2,214	37,263	534	11,005	77	4,625	4.8
1989	4,528	63,184	4,299	61,618	4,294	61,563	2,420	41,143	581	12,600	98	6,578	5.1

Notes: • To obtain the Relative Standard Error (RSE) percentage for any table cell, multiply the corresponding RSE column factor by the corresponding RSE row factor for the cell. • See "Glossary" for definition of terms used in this report.

Source: Energy Information Administration, Office of Energy Markets and End Use, Forms EIA-143, 788, and 871 of the 1979, 1983, and 1986 Nonresidential Buildings Energy Consumption Surveys, and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

Table 3.2b. Energy Sources Used for Space Heating in Commercial Buildings, Number of Buildings and Total Floorspace

Year of Survey	All Commercial Buildings		Energy Sources										RSE Row Factors
			Any Energy Source		Electricity		Natural Gas		Fuel Oil		District Heat		
	Buildings (thousand)	Floorspace (million sq. ft.)	Buildings (thousand)	Floorspace (million sq. ft.)	Buildings (thousand)	Floorspace (million sq. ft.)	Buildings (thousand)	Floorspace (million sq. ft.)	Buildings (thousand)	Floorspace (million sq. ft.)	Buildings (thousand)	Floorspace (million sq. ft.)	
RSE Column Factors:	0.6	0.6	0.6	0.6	1.3	1.2	0.9	0.8	1.4	1.1	2.3	2.1	
1979	3,073	43,546	2,814	41,424	769	10,724	1,605	23,725	593	9,186	44	3,586	9.7
1983	3,185	49,471	2,808	45,685	892	15,325	1,671	26,885	397	6,835	54	4,297	9.3
1986	4,154	58,199	3,626	53,915	1,166	18,223	2,018	31,542	504	8,708	74	4,389	5.5
1989	4,528	63,184	3,876	57,868	1,283	18,702	2,158	33,017	555	10,526	94	6,065	6.0

Notes: • To obtain the Relative Standard Error (RSE) percentage for any table cell, multiply the corresponding RSE column factor by the corresponding RSE row factor for the cell. • See "Glossary" for definition of terms used in this report.

Source: Energy Information Administration, Office of Energy Markets and End Use, Forms EIA-143, 788, and 871 of the 1979, 1983, and 1986 Nonresidential Buildings Energy Consumption Surveys and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

Table 3.3. Major End Uses by Energy Source Used in Residential Buildings Number of Buildings
(thousand)

Year of Survey	All Residential Buildings	End-Uses by Type of Energy Source							RSE Row Factors
		Electricity			Natural Gas		Fuel Oil		
		Main Space Heating	Water Heating	Air Conditioning	Main Space Heating	Water Heating	Main Space Heating	Water Heating	
RSE Column Factors:	0.3	1.8	1.1	0.9	0.8	0.8	1.6	2.3	
1980	65,471	9,999	21,991	35,764	36,293	35,204	9,299	3,996	4.2
1981	66,210	9,088	22,514	34,988	38,073	36,755	8,177	3,436	4.3
1982	66,210	9,125	22,078	34,900	37,528	36,377	8,289	3,073	4.5
1984	67,576	10,012	24,121	37,403	37,023	35,126	7,749	2,926	4.1
1987	70,446	11,869	26,532	42,722	39,075	36,553	8,096	2,661	4.3
1990	74,213	14,480	28,023	47,739	41,528	38,924	8,228	3,225	4.2

Notes: • To obtain the Relative Standard Error (RSE) percentage for any table cell, multiply the corresponding RSE column factor by the corresponding RSE row factor for the cell. • See "Glossary" for definition of terms used in this report.

Source: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1980, 1981, 1982, 1984, 1987, and 1990 Residential Energy Consumption Surveys.

Table 3.4. Major End Uses by Energy Sources Used in Commercial Buildings Number of Buildings
(thousand)

Year of Survey	All Commercial Buildings	End-Uses by Type of Energy Source							RSE Row Factors
		Electricity			Natural Gas		Fuel Oil		
		Space Heating	Water Heating	Cooling	Space Heating	Water Heating	Space Heating	Water Heating	
RSE Column Factors:	0.6	1.3	0.9	0.7	0.9	0.8	1.4	2.0	
1979	3,073	769	998	1,935	1,605	1,024	593	125	9.5
1983	3,185	892	1,186	2,089	1,671	1,130	397	109	9.1
1986	4,154	1,166	1,387	2,712	2,018	1,323	504	132	5.2
1989	4,528	1,283	1,554	3,072	2,158	1,391	555	126	6.3

Notes: • To obtain the Relative Standard Error (RSE) percentage for any table cell, multiply the corresponding RSE column factor by the corresponding RSE row factor for the cell. • See "Glossary" for definition of terms used in this report.

Source: Energy Information Administration, Office of Energy Markets and End Use, Forms EIA-143, 788, and 871 of the 1979, 1983, and 1986 Nonresidential Buildings Energy Consumption Surveys and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

Table 3.5 Energy Sources Used for Main Space Heating in Residential Buildings, 1980 and 1990
Number of Buildings
(thousand)

Building Characteristics	Electricity		Natural Gas		Fuel Oil		RSE Row Factors
	1980	1990	1980	1990	1980	1990	
RSE Column Factors:	1.2	1.3	0.7	0.7	1.2	1.2	
All Buildings	9,999	14,480	36,293	41,528	9,299	8,228	5.8
Census Region							
Northeast	1,035	1,280	4,740	6,282	5,203	5,313	12.1
Midwest	1,379	1,531	12,179	13,359	1,405	1,174	12.9
South	5,708	8,673	10,460	12,327	2,222	1,457	11.2
West	1,876	2,996	8,914	9,561	468	Q	11.3
Census Division							
New England	175	254	560	747	1,618	1,833	13.2
Middle Atlantic	860	1,025	4,180	5,534	3,585	3,481	15.0
East North Central	1,009	1,083	8,296	9,400	1,014	907	16.4
West North Central	370	448	3,883	3,959	391	267	18.4
South Atlantic	3,264	5,788	3,321	4,103	2,129	1,332	17.2
East South Central	1,549	1,487	1,884	2,405	84	Q	17.0
West South Central	896	1,398	5,255	5,818	Q	*	14.4
Mountain	493	704	2,455	3,082	Q	Q	19.7
Pacific	1,383	2,292	6,459	6,479	394	Q	11.4
Type of Home							
Mobile Home	1,075	1,133	1,364	1,975	389	283	26.1
Single-Family Detached	7,656	9,758	30,066	33,957	7,469	6,732	6.3
Single-Family Attached	504	2,453	1,940	2,754	738	684	19.6
2 to 4 Units	489	725	2,478	2,345	610	456	15.3
5 or More Units	275	411	446	497	92	73	16.3
Building Floorspace (square feet)							
Fewer than 1,001	1,692	2,325	5,105	4,598	740	606	13.2
1,001 to 2,000	4,061	5,718	14,428	15,996	2,561	2,029	8.2
2,001 to 5,000	3,831	5,937	15,721	19,290	5,445	5,177	7.4
5,001 to 10,000	334	360	920	1,412	478	380	16.3
10,001 to 25,000	63	113	100	201	60	Q	28.1
25,001 to 50,000	11	11	12	17	Q	Q	34.1
50,001 to 100,000	2	14	Q	Q	5	Q	20.3
100,001 to 200,000	3	1	Q	3	2	Q	38.8
Over 200,000	Q	Q	Q	1	1	1	21.4
Year Constructed							
1939 or Before	672	814	10,226	10,588	4,133	2,946	10.5
1940 to 1949	335	536	3,910	4,099	1,089	663	14.0
1950 to 1959	974	1,128	8,384	7,628	1,944	1,898	10.6
1960 to 1969	1,801	1,675	7,312	7,226	1,220	1,281	10.8
1970 to 1979	5,651	4,925	5,962	7,075	899	1,161	10.8
1980 to 1990	566	5,402	499	4,912	14	278	19.6

* = Value rounds to zero in the units displayed.

Q = Data withheld either because the Relative Standard Error (RSE) was greater than 50 percent or fewer than 10 households were sampled.

Notes: • To obtain the RSE percentage for any table cell, multiply the corresponding RSE column factor by the corresponding RSE row factor for the cell. • Because of rounding, data may not sum to totals. • See "Glossary" for definition of terms used in this report.

Source: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1980 and 1990 Residential Energy Consumption Surveys.

Table 3.6. Energy Sources Used for Space Heating in Commercial Buildings, 1979 and 1989
Number of Buildings
(thousand)

Building Characteristics	Electricity		Natural Gas		Fuel Oil		RSE Row Factors
	1979	1989	1979	1989	1979	1989	
RSE Column Factors:	1.3	0.8	0.9	0.6	1.2	1.3	
All Buildings	769	1,283	1,605	2,158	593	555	9.2
Census Region							
Northeast	76	136	254	300	220	298	14.4
Midwest	116	159	681	705	142	86	15.4
South	420	703	422	690	179	150	17.1
West	156	284	249	462	52	22	14.8
Principal Building Activity							
Assembly	100	187	243	311	121	98	16.0
Education	39	54	74	182	42	36	17.1
Food Sales and Service	93	104	166	186	39	36	17.5
Health Care	11	37	31	36	8	12	25.8
Lodging	46	64	35	66	15	11	21.0
Mercantile and Service	193	351	579	687	211	216	11.7
Office	161	283	245	356	64	58	13.0
Warehouse	81	112	152	195	61	48	14.8
Other	27	41	47	65	22	28	19.7
Vacant	19	49	33	76	8	14	26.7
Building Floorspace (square feet)							
1,001 to 2,000	121	251	240	397	83	117	13.7
2,001 to 5,000	243	415	489	715	181	180	11.9
5,001 to 10,000	186	228	398	485	156	95	13.5
10,001 to 25,000	136	239	289	303	102	89	12.5
25,001 to 50,000	45	85	105	134	39	33	12.6
50,001 to 100,000	25	39	50	75	16	21	13.2
100,001 to 200,000	7	17	24	32	10	14	13.5
200,001 to 500,000	3	6	9	14	5	4	16.5
Over 500,000	1	2	1	3	1	3	26.2
Year Constructed							
1899 or Before	15	41	99	88	48	31	25.4
1900 to 1919	37	45	212	141	67	33	17.3
1920 to 1945	101	117	384	345	146	137	13.3
1946 to 1959	139	179	341	473	156	136	13.6
1960 to 1969	174	218	326	409	87	88	13.9
1970 to 1979	302	333	244	364	89	85	13.1
1980 to 1989	--	350	--	338	--	45	11.9

Notes: • To obtain the Relative Standard Error (RSE) percentage for any table cell, multiply the corresponding RSE column factor by the corresponding RSE row factor for the cell. • See "Glossary" for definition of terms used in this report.

Source: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-143 of the 1979 Nonresidential Buildings Energy Consumption Survey and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

4. Energy Consumption and Expenditures

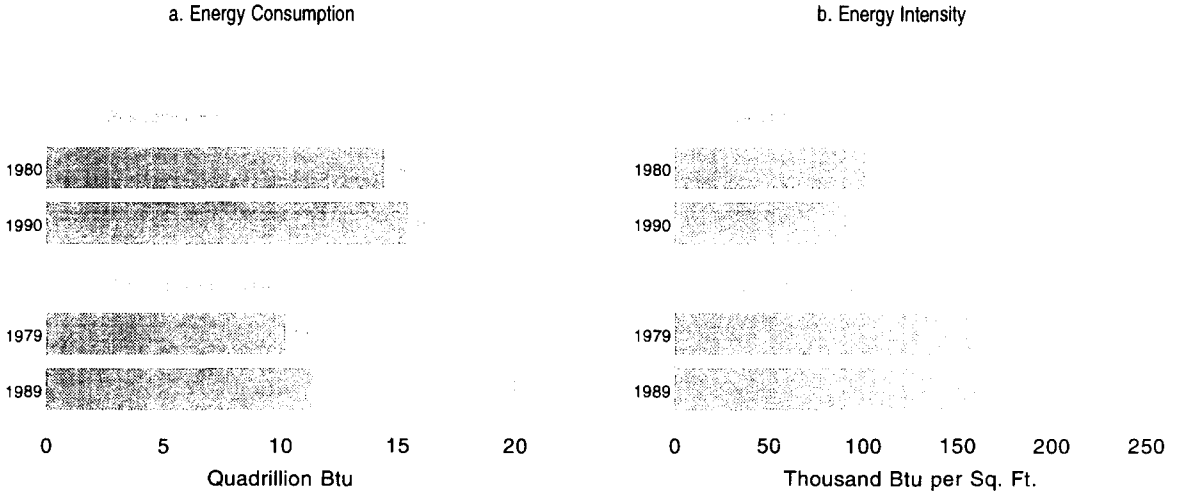
Consumption and Energy Intensities for Major Energy Sources

Throughout the 1980's, energy consumption in residential buildings was greater than in commercial buildings (Figure 4.1a). However, when difference in size between residential and commercial buildings was taken into account, the energy intensity in commercial buildings was shown to be twice that in residential buildings (Figure 1b).[6] This difference was due to the more intensive use of energy-demanding equipment in commercial buildings, and in many cases, longer hours of operation. In residential buildings energy-consuming equipment is typically operated less intensively during the day, when the occupants are gone, or at night, when they are asleep, for fewer hours of intensive operation overall.

In the 1980's:

- Residential building consumption increased to 15.4 quadrillion Btu by 1990, while energy intensity declined from 100 thousand Btu per square foot in 1980 to just over 90 thousand in 1990 (Figures 4.1a and b).
- By 1989, commercial building consumption was 11.4 quadrillion Btu (Figure 4.1a).[7] Energy intensity in commercial buildings declined from 203 thousand Btu per square foot in 1979 to 180 thousand in 1989 (Figure 4.1b).

Figure 4.1. Residential and Commercial Buildings Energy Consumption and Energy Intensity in the 1980's



Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1980 and 1990 Residential Energy Consumption Surveys; Form EIA-143 of the 1979 Nonresidential Buildings Energy Consumption Survey, and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

[6]Energy intensity is defined as energy consumed per square foot of floorspace. Energy intensities for specific energy sources apply to only the floorspace that used the energy source.

[7]The apparent increase in commercial buildings cannot be confirmed because of the effect of the 1979 building undercount noted in Appendix C. If the reported 1979 consumption is adjusted by applying the 1979 intensity to adjusted floorspace, then the reported 1979 consumption (8.8 quadrillion Btu) rises to 10.2 quadrillion Btu, within the statistical uncertainty of the 1989 consumption estimate of 11.4 quadrillion Btu.

Electricity and natural gas were the two major sources of energy consumed in both residential and commercial buildings (Figures 4.2 and 4.3).[8] Appliances and lighting were the major electricity end uses, while space heating was the major natural gas end use.[9]

- The major source of primary energy consumption in residential buildings was electricity, which accounted for more than nine quadrillion Btu by 1990, followed by natural gas at five quadrillion Btu. Fuel oil and LPG were consumed in much smaller quantities (Figure 4.2a).[10]

- In commercial buildings, electricity consumption accounted for 4 times as much energy as natural gas, followed by smaller levels of fuel oil and district heat consumption (Figure 4.3a).

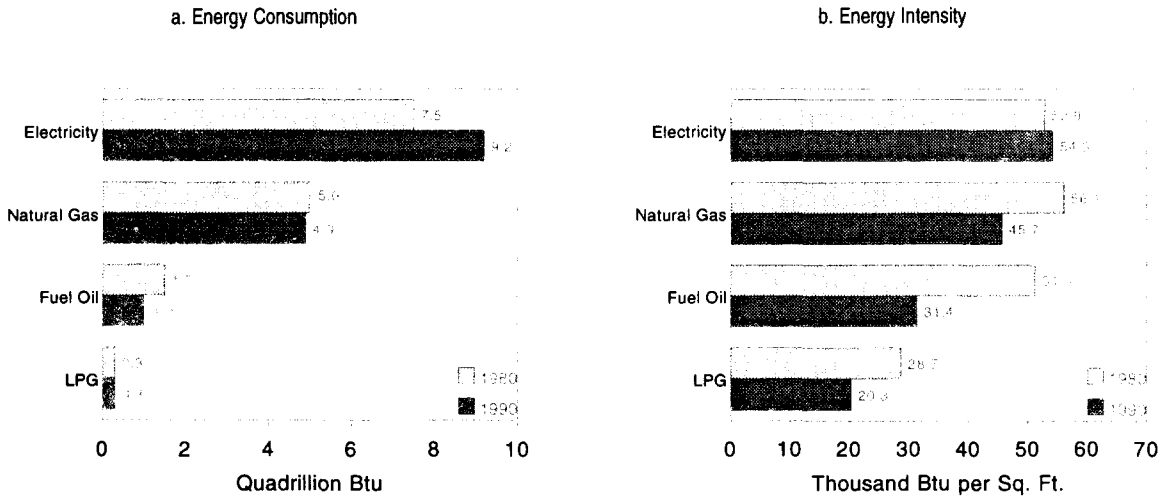
In the 1980's:

- Electricity consumption increased and fuel oil consumption declined in residential buildings. The former was due to the demand for additional appliances and equipment. Natural gas consumption and LPG consumption were unchanged (Figure 4.2a).

- In both sectors, energy intensity declined for all sources except electricity, which showed no change (Figures 4.2b and 4.3b). The increase for district heat is explained by differences in surveys. In 1989, purchased and nonpurchased steam and hot water were included; in 1979, only purchased steam was included.

- Although electricity consumption increased due to the increased demand for services and increase in total floorspace, its intensity held steady due to the improved efficiency of its use (Figures 4.2a and b, 4.3a and b).

Figure 4.2. Residential Buildings Energy Consumption and Energy Intensity by Source, 1980 and 1990



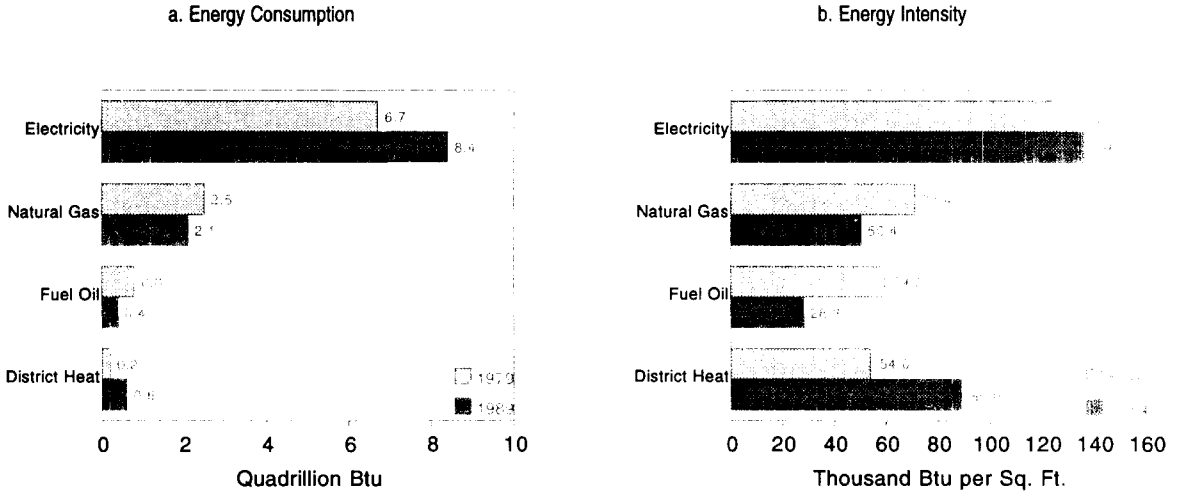
Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1980 and 1990 Residential Energy Consumption Surveys.

[8]The electricity consumption statistics in this report are for primary energy consumption and include electrical system energy losses. Primary energy consumption takes into account the fuels that are used to produce and distribute electricity. All other energy sources are reported as site consumption. See *Assessment of Energy Use in Multibuilding Facilities*, DOE/EIA-0555(93)/1 for discussion of primary district heat consumption.

[9]Space heating and air conditioning energy consumption are not adjusted for the effect of weather.

[10]Kerosene is combined with fuel oil. Total kerosene consumption in residential buildings was 0.1 quadrillion Btu or less.

Figure 4.3. Commercial Buildings Energy Consumption and Energy Intensity by Source, 1979 and 1989*



*1979 includes only purchased steam, 1989 includes purchased and nonpurchased steam and purchased and nonpurchased hot water.

Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-143 of the 1979 Nonresidential Buildings Energy Consumption Survey and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

Consumption and Energy Intensity by End Use

Across all buildings, residential appliances and space heating were the end uses that consumed the greatest amount of energy.[11] In residential buildings, water heating consumed between 2.4 quadrillion Btu, while air conditioning consumed up to 1.5 quadrillion Btu (Figure 4.4a). The second largest end use in commercial buildings was space heating at 2.2 quadrillion Btu.[12]

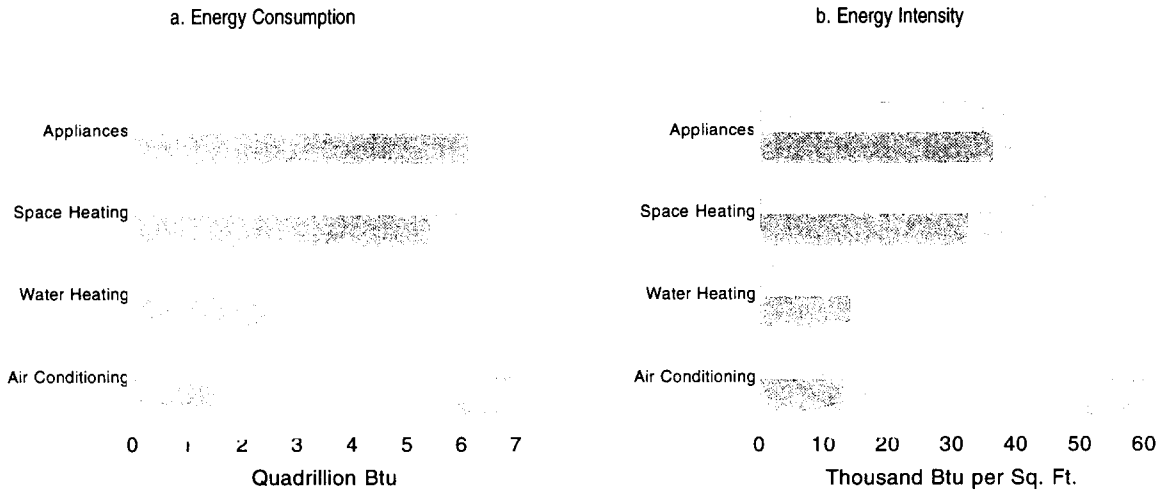
Energy intensities for residential appliances and space heating were comparable to each other and more than twice the intensities of water heating or air conditioning (Figure 4.4b). Improvements in the efficiency of new equipment and appliances attained during the 1980's did not have a large enough impact to reduce the average intensity of the entire building stock. Space heating intensity declined while changes in the other end-use intensities were minor. The decline in space heating intensity can be attributed, at least partially, to the warmer winter weather in 1990.[13]

[11]Space heating and air conditioning energy consumption were not adjusted for the effect of weather.

[12]End-use consumption estimates for commercial buildings are only available for the 1989 survey. For additional information on these estimates, see *Energy End-Use Intensities in Commercial Buildings*, DOE/EIA-0555(94)/2 (Washington, DC, September 1994).

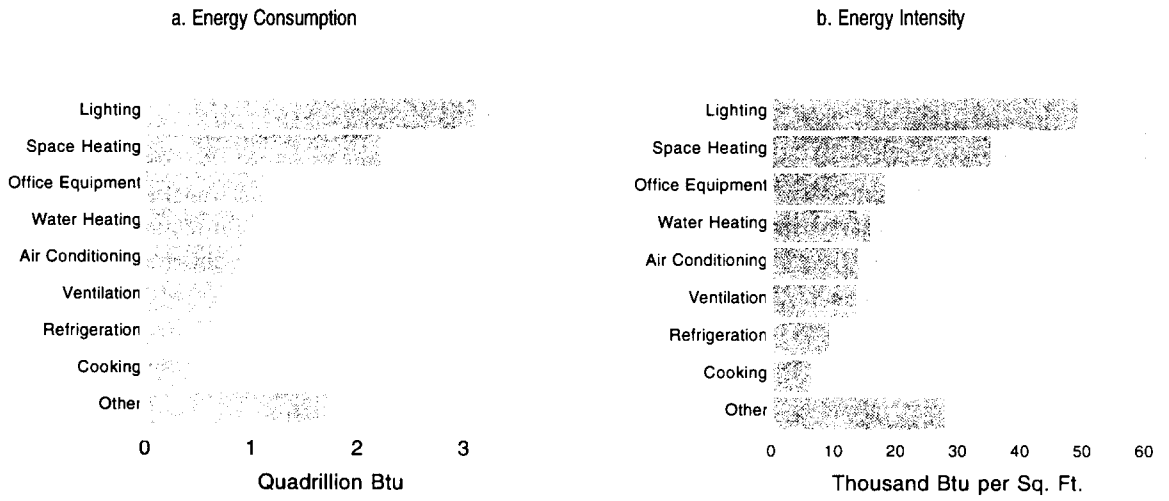
[13]See Figure 2, *Household Energy Consumption and Expenditures 1990*, DOE/EIA-0321(90) (Washington, DC, February, 1993).

Figure 4.4. Residential Buildings Energy Consumption and Energy Intensity by End Use, 1980 and 1990



Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1980 and 1990 Residential Energy Consumption Surveys.

Figure 4.5. Commercial Buildings Energy Consumption and Energy Intensity by End Use, 1989



Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

Energy Consumption by Source and End Use

Electricity dominates as an energy source because of its unique ability to provide many different kinds of desired services (e.g., lighting, household appliances), its universal availability, and its flexibility--all electric houses are common, all natural gas or fuel oil are not, since they cannot provide energy for all end uses.

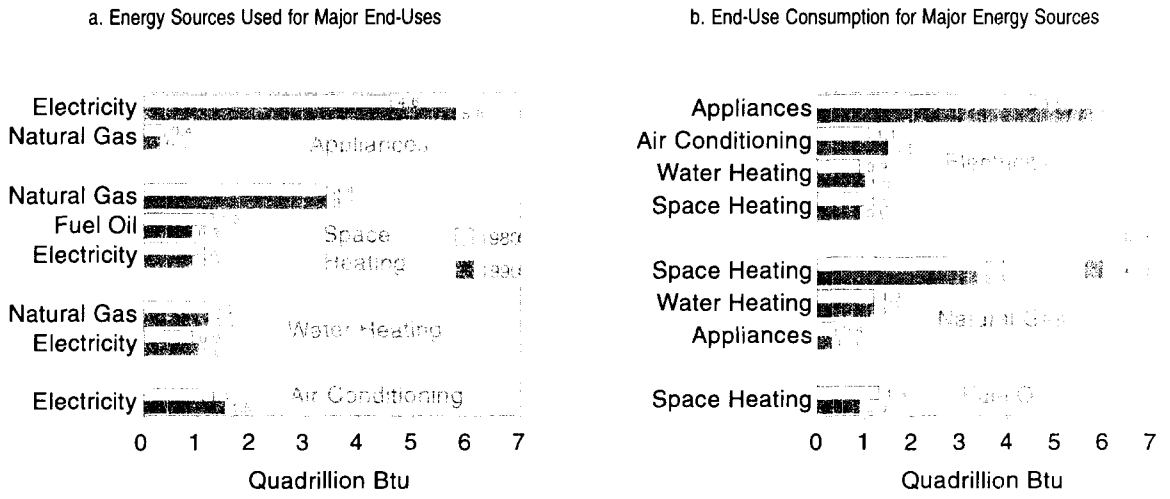
In residential buildings, energy was used primarily for appliances and space heating . Electricity consumption for appliances exceeded that of any other source (Figure 4.6a). Electricity consumption for appliances was nearly four times the consumption for any other electricity end use (Figure 4.6b).

Natural gas was the major energy source consumed for space heating, accounting for more than twice as much consumption than any other source (Figure 4.6a). Natural gas space heating consumption exceeded that of any other natural gas end use by more than two times in residential buildings and four times in commercial buildings (Figures 4.6 and 4.7).

During the 1980's, the two major changes in end-use consumption in residential buildings were an increase in electricity consumption for appliances and a decline in fuel oil consumption for space heating (Figures 4.6a and b). The former may be ascribed to the use of additional appliances (e.g., microwave ovens, water bed heaters, personal computers and printers) and the latter to the choice of other energy sources (natural gas or electricity) for space heating.

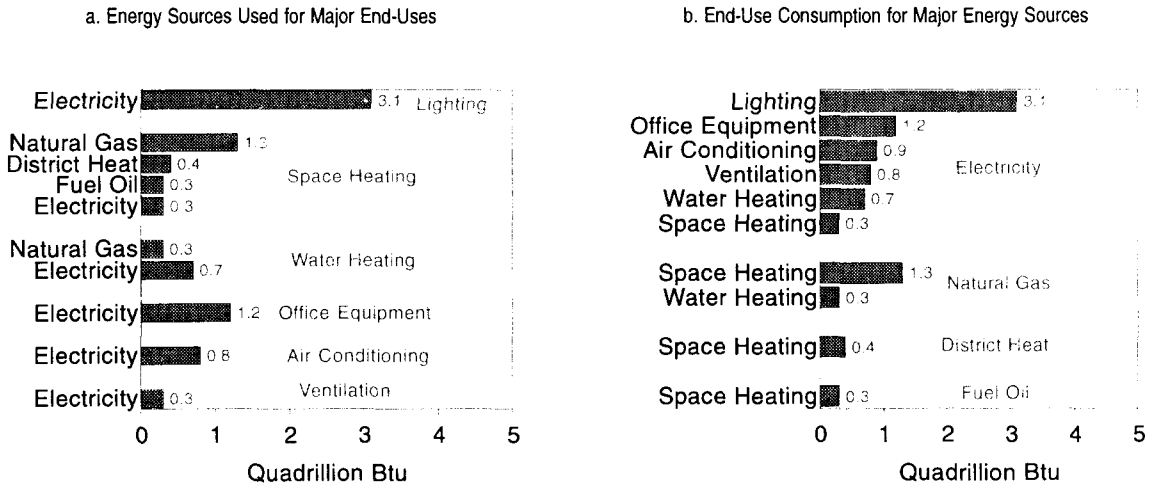
In commercial buildings, natural gas was devoted primarily to space heating; for all other end uses, electricity was the major energy source (Figure 4.7a). Lighting exceeded office equipment by more than two times as the major consumer of electricity (Figure 4.7b).

Figure 4.6. Energy Consumption by Energy Source and End Use in Residential Buildings, 1980 and 1990.



Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1980 and 1990 Residential Energy Consumption Surveys.

Figure 4.7. Energy Consumption by Energy Source and End Use in Commercial Buildings, 1989.*



*End-use consumption estimates are available only for the 1989 survey.

Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

Energy Expenditures

Total energy expenditures for single-family detached homes far exceeded the total energy expenditures for all other building types, consistent with the dominance of energy consumption in these buildings (Figure 1.6). Total expenditures for energy (expressed in constant 1987 dollars) were about 50 percent greater for residential buildings than for commercial buildings (Figure 4.8).[14] In residential buildings, appliances and space heating constituted the greatest expenditure among end uses, but for different reasons (Figure 4.9).[15] Space heating expenditures were driven by the large quantities of energy consumed (see Figure 4.4a), while appliances expenditures were driven by the predominance of electricity as the energy source, the most expensive source on a per Btu basis. In both sectors, expenditures for electricity were greatest, more than twice those of natural gas in residential buildings and eight times those for commercial buildings (Figures 4.10a and b).

During the 1980's, total expenditures for energy in residential buildings declined (Figure 4.8). Electricity expenditures increased and fuel oil expenditures declined in residential buildings (Figure 4.10a). In residential buildings, expenditures for space heating and appliances were at nearly identical levels at the beginning of the decade, then diverged mid-decade when expenditures for space heating declined. By 1990, expenditures for appliances exceeded expenditures for space heating by 13.5 billion dollars (Figure 4.9). The divergence reflected increased consumption for appliances and rising electricity prices, along with the decline in natural gas prices from a peak in the mid-1980's.

When expenditures are considered relative to consumption (expenditure intensity in dollars expended for each million Btu consumed), at the end of the decade electricity per Btu of primary consumption was 41 percent more expensive than natural gas in residential buildings and 49 percent more expensive in commercial buildings (Figures 4.11 a and b).[16]

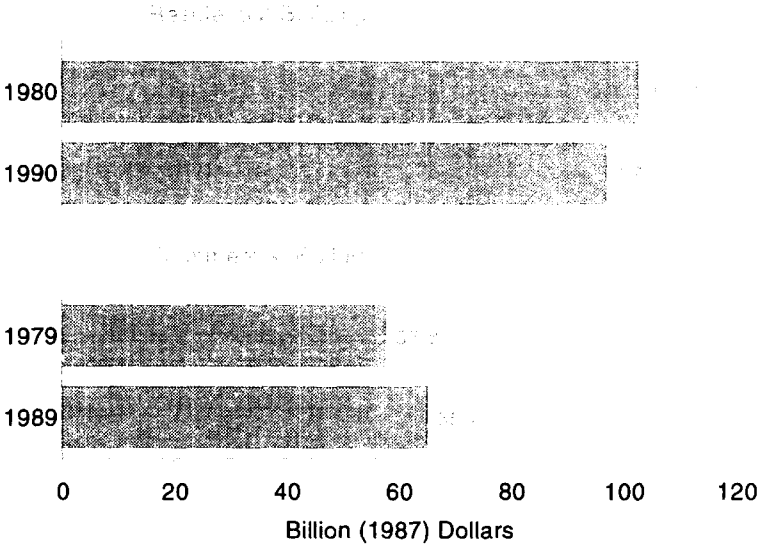
---

[14]See Appendix C, "Data Quality", for adjustment of expenditures to 1987 dollars.

[15]There are no estimates available of expenditures by end-use for commercial buildings.

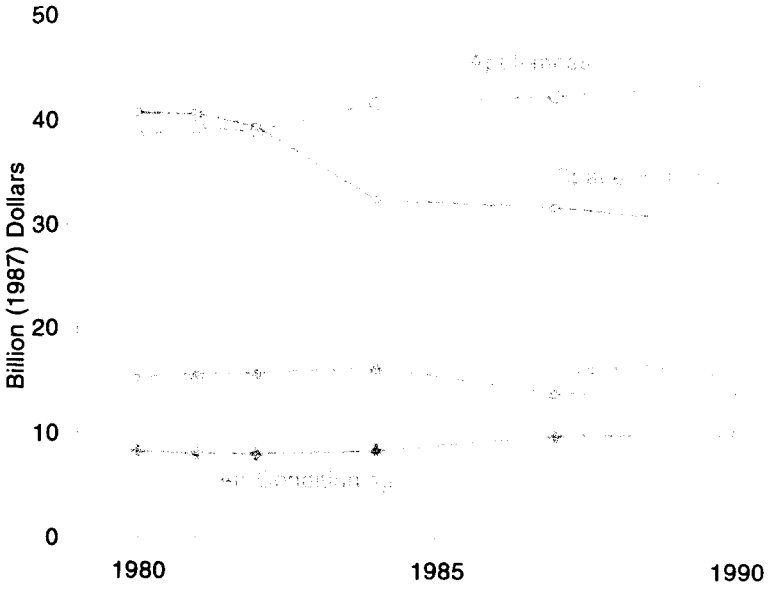
[16]Intensities for all major sources and electricity refer to primary electricity consumption.

Figure 4.8. Total Expenditures (1987 Dollars) for Energy in Residential and Commercial Buildings in the 1980's



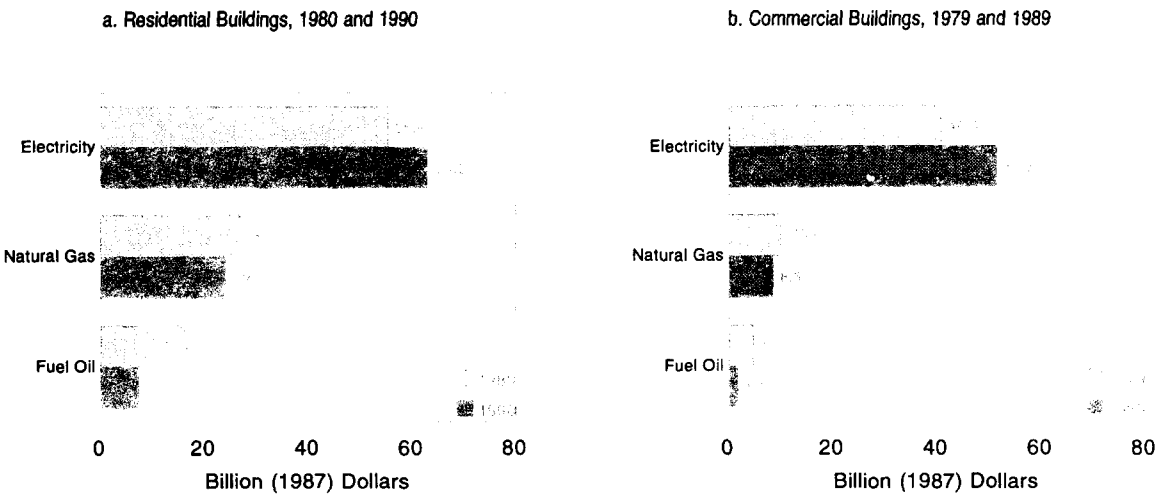
Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1990 Residential Energy Consumption Surveys and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

Figure 4.9. Expenditures (1987 Dollars) for End Uses in Residential Buildings in the 1980's



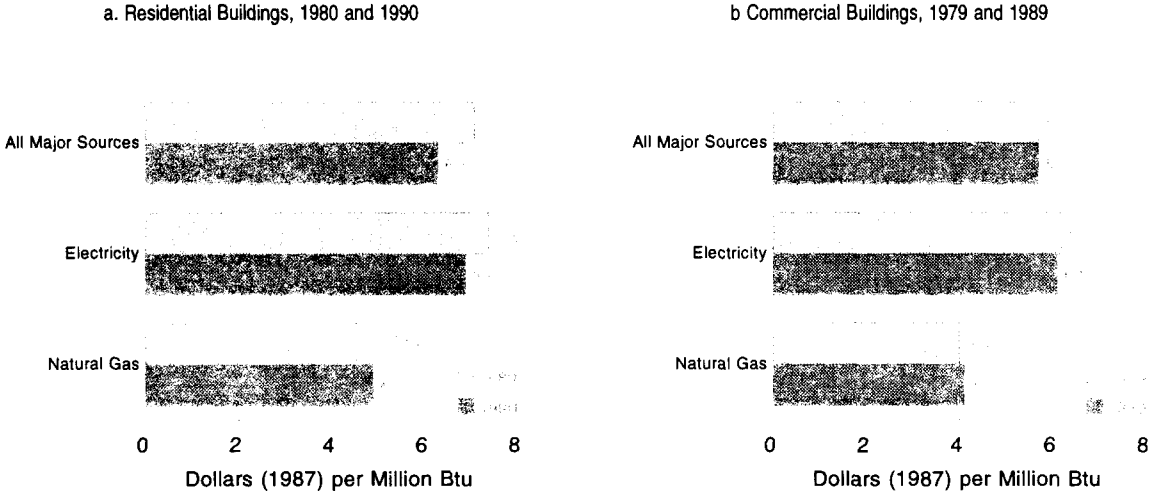
Sources: Energy Information Administration, Office of Energy Markets and End Use, Forms EIA-457 of the 1980, 1981, 1982, 1984, 1987, and 1990 Residential Energy Consumption Surveys.

Figure 4.10. Residential and Commercial Buildings Expenditures (1987 Dollars) by Energy Source



Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1980 and 1990 Residential Energy Consumption Surveys; Form EIA-143 of the 1979 Nonresidential Buildings Energy Consumption Survey, and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

Figure 4.11. Residential and Commercial Buildings Expenditure Intensities (1987 Dollars) by Energy Source



Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1980 and 1990 Residential Energy Consumption Surveys; Form EIA-143 of the 1979 Nonresidential Buildings Energy Consumption Survey, and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

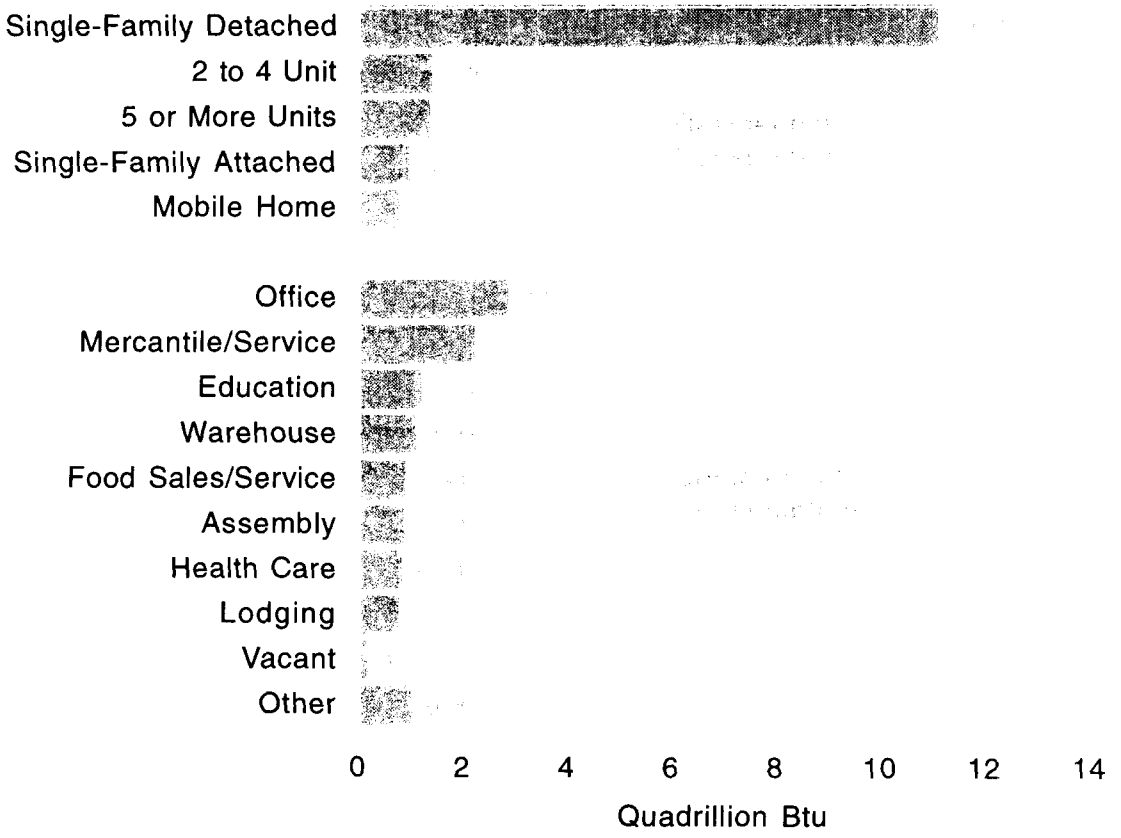
Energy Consumption and Characteristics of Residential and Commercial Buildings

In the following sections, energy consumption is broken down by major building characteristics. These differing characteristics--building type, size of building, Census region, and year of construction--can affect the amount of energy consumed, because of differing end uses and differing amounts of consumption by energy source. For each of these characteristics, comparisons are made between residential and commercial buildings, and between the beginning and end of the 1980's.

Type of Building

The single family detached home dominated all other single building types in energy consumption (Figure 4.12), as well as in number of buildings, total floorspace, and total expenditures. The total energy consumption of single-family detached homes at the end of the decade, however, was only slightly greater than the of consumption in commercial buildings, a fact that reflects the greater consumption intensity in commercial buildings. Energy consumption in other residential building types comprised about one fourth of total residential consumption.

Figure 4.12. Total Primary Energy Consumption by Building Type, 1990 RECS and 1989 CBECS



Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1990 Residential Energy Consumption Survey and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

Within the residential sector, more than 70 percent of energy consumption was in single-family detached homes. Other residential building types each accounted for only four to twelve percent of total energy consumption (Figure 4.13a). Total energy intensities were lowest for single-family detached and attached homes, and greatest for multi-unit (two to four units and five or more units) buildings and mobile homes (Figure 4.13b).

Within the commercial sector, the three largest energy-consuming commercial building types were office buildings, mercantile and service buildings, and education buildings. Combined, these three used slightly more than half of commercial consumption and had energy intensities of less than 240 thousand Btu per square foot. In contrast, energy intensities were greatest for health care buildings, and food sales and service buildings, both in excess of 320 thousand Btu per square foot, but combined, these two used less than 15 percent of total consumption (Figures 4.14a and b). The remaining commercial building types were comparable to each other in consumption levels, each consuming between six and ten percent of total commercial consumption.

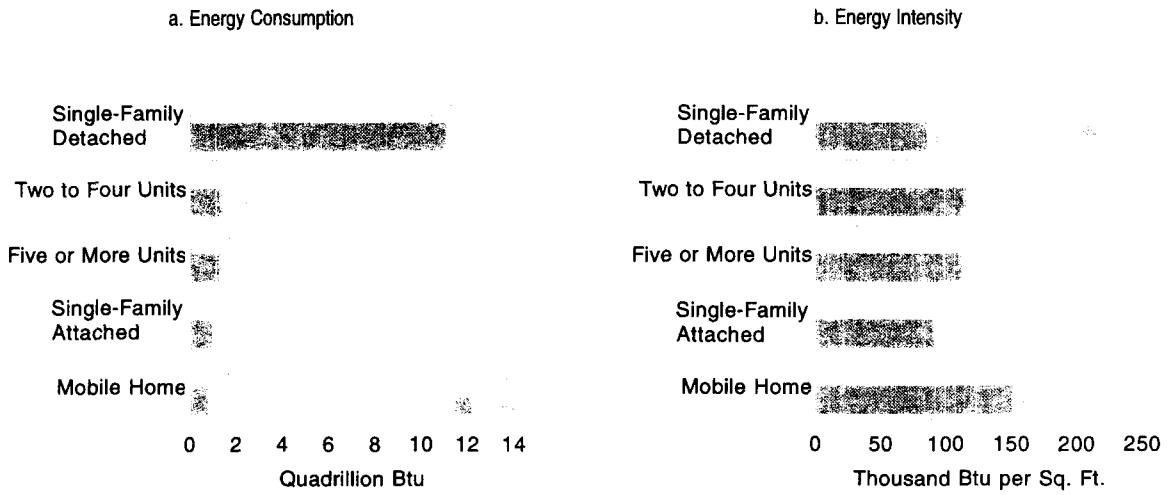
Intensity of energy use does not directly correlate with energy consumption. Natural gas energy intensities were largely comparable in both residential and commercial buildings, with the highest levels being for health care buildings, food sales and service buildings, lodging buildings, and mobile homes (Figures 4.15a and 4.16a).[16] Electricity intensities in all types of residential buildings, except electricity-intensive mobile homes, were similar to each other and lower than in commercial building types. Electricity intensities in commercial buildings, on the other hand, were much more variable than in residential buildings, with the highest values in food sales and service buildings and health care buildings, where there was especially intensive use of equipment and appliances.

The following trends were observed in the 1980's:

- Energy intensities declined most in multi-unit residential buildings and mobile homes (Figure 4.13b).
- There were variable changes in consumption by type of commercial building. In offices and mercantile buildings consumption increased, in warehouses consumption decreased, and in other commercial buildings consumption was roughly constant during the decade (Figure 4.14a).
- Natural gas intensities either declined or showed no significant change in residential and commercial buildings (Figures 4.15a and 4.16a).
- Changes in electricity intensities showed no consistent trend. Electricity intensities in single-family attached homes, mercantile and service buildings, health care buildings, and food sales and service buildings increased, while in mobile homes, warehouses, and commercial lodging buildings intensities declined. All other residential and commercial types showed essentially no changes (Figures 4.15a and 4.16b).

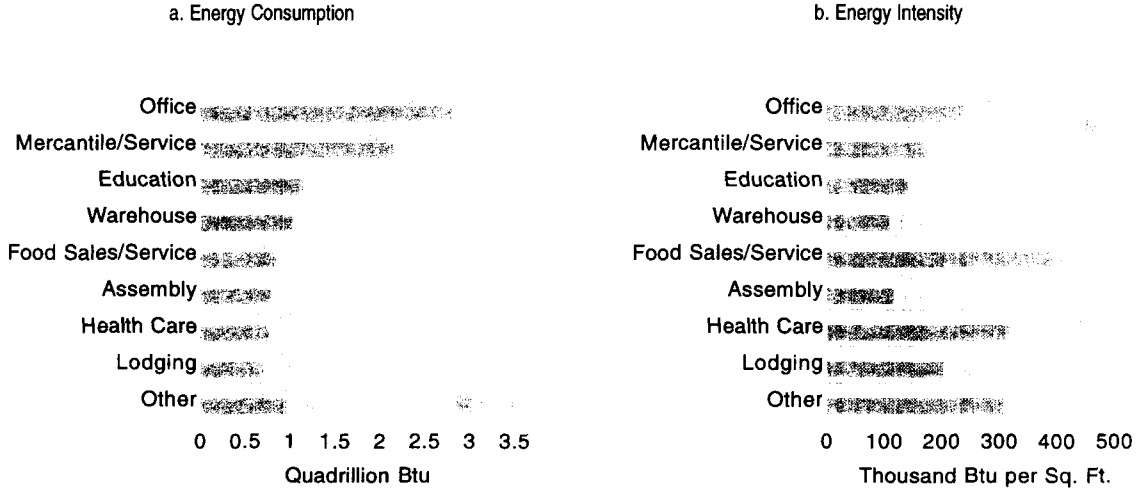
[16]Energy intensities for specific energy sources apply to only the floorspace that used the source.

Figure 4.13. Primary Energy Consumption and Energy Intensity by Type of Residential Building, 1980 and 1990



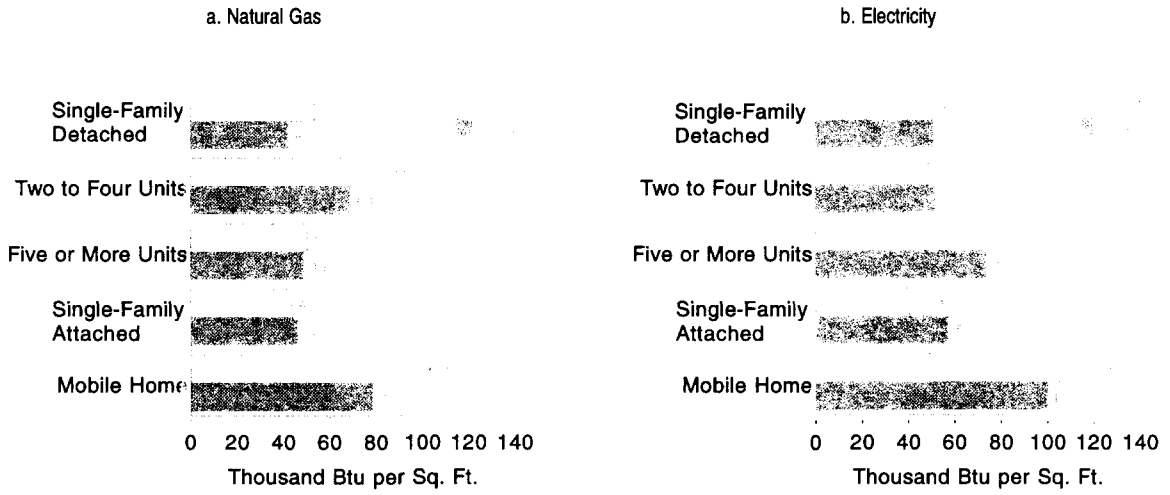
Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1980 and 1990 Residential Energy Consumption Surveys.

Figure 4.14. Primary Energy Consumption and Energy Intensity by Type of Commercial Building, 1979 and 1989



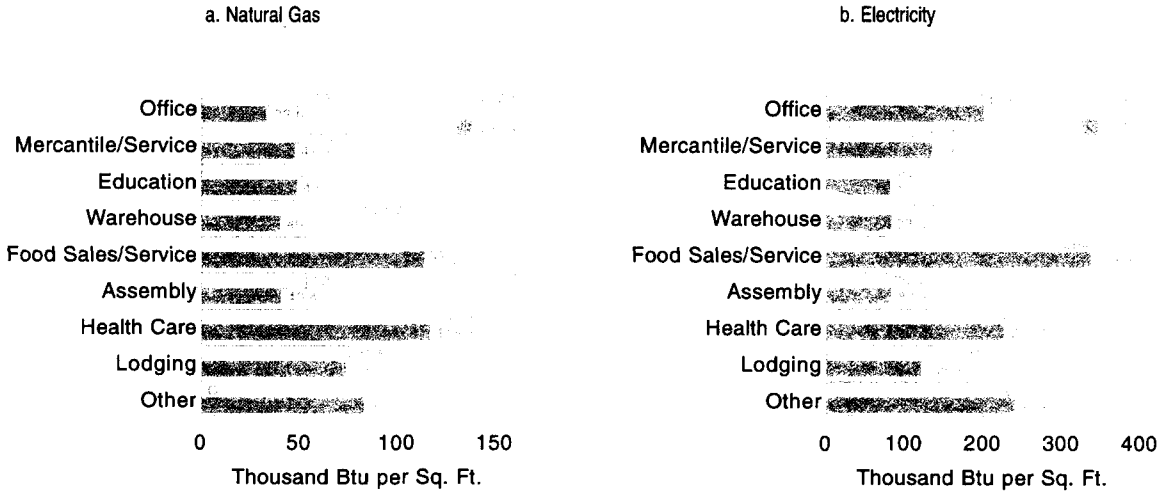
Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-143 of the 1979 Nonresidential Buildings Energy Consumption Survey and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

Figure 4.15. Natural Gas and Electricity Energy Intensity by Type of Residential Building, 1980 and 1990



Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1980 and 1990 Residential Energy Consumption Surveys.

Figure 4.16. Natural Gas and Electricity Energy Intensity by Type of Commercial Building, 1979 and 1989



Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-143 of the 1979 Nonresidential Buildings Energy Consumption Survey and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

Size of Building

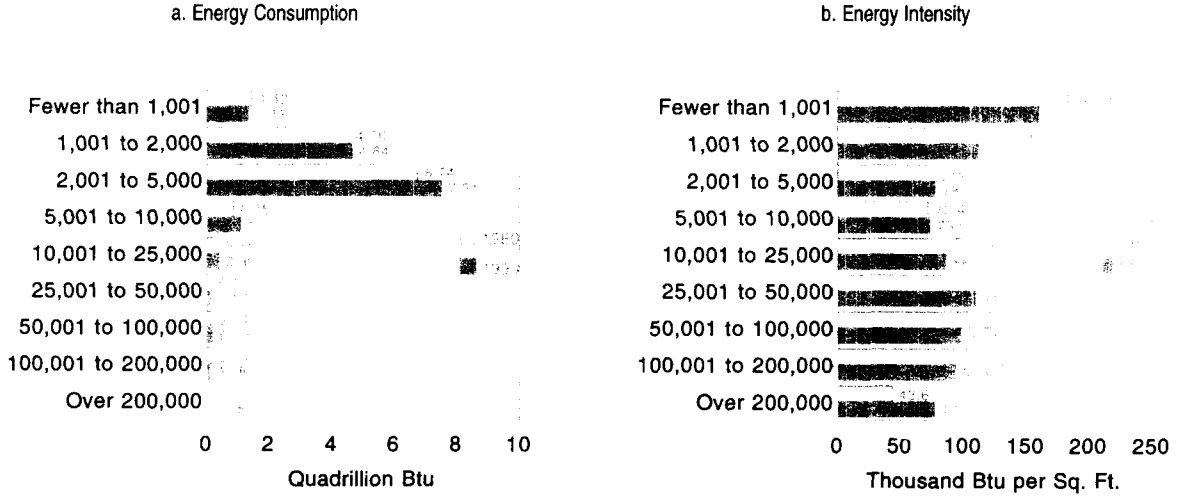
Energy consumption in residential buildings was concentrated in two size categories (encompassing buildings between 1,000 and 5,000 square feet in size), while commercial building consumption was more evenly distributed across all building sizes (Figures 4.17a and 4.18a). In the residential sector, nearly three-fourths of residential consumption occurred in the 1,001 to 5,000 square feet categories, which are the two categories that contain essentially all single-family detached homes (Figure 4.17a).

In both residential and commercial buildings, energy intensities were highest for the smallest size categories. Natural gas intensities were greatest for the smallest residential and commercial buildings and for the same size categories, residential intensities were lower (Figures 19a and 20a). Electricity intensities showed roughly similar distributions, with the highest levels in the smallest buildings. As with natural gas, electricity intensities were much lower in residential buildings than commercial buildings for the same size categories (Figures 4.19b and 4.20b). The fact that the smallest buildings had the higher intensities is explained by the type of buildings found in these size categories. In the commercial sector, the two most abundant building types were food sales and service buildings and health care buildings, the two types with the highest energy intensities. In the residential sector, the type that had the highest intensities, mobile homes, were found only in the smallest size categories.

During the 1980's:

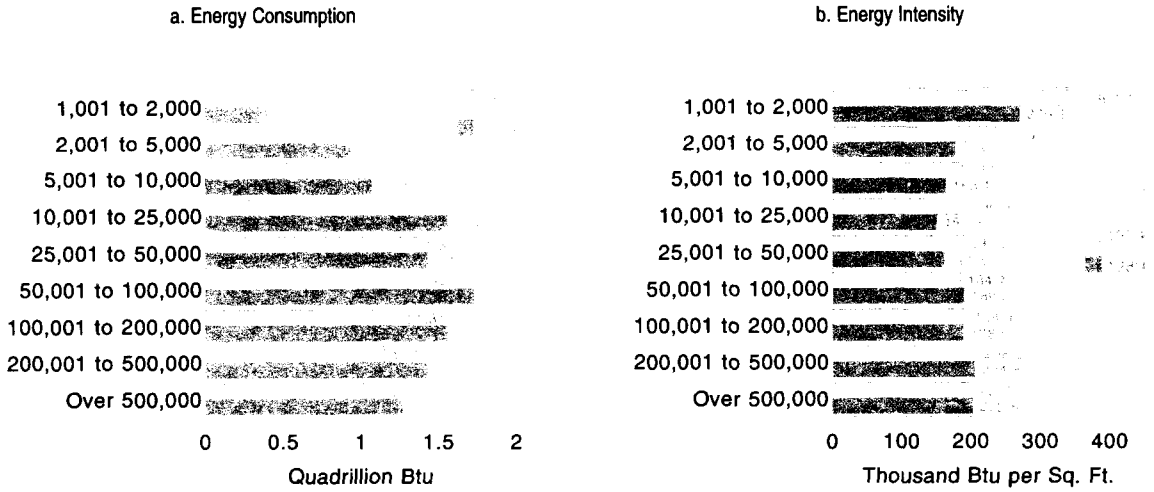
- Intensities declined or were unchanged in residential buildings (Figure 4.17b).
- Each of the categories of commercial buildings smaller than 25,000 square feet declined in energy intensity, while larger buildings showed no significant change (Figure 4.18b).
- Natural gas intensities declined, or remained unchanged, for all sizes of residential and commercial buildings. The increase for commercial buildings in the 25,001 to 50,000 category was not statistically significant (Figures 4.19a and 4.20a).

Figure 4.17. Primary Energy Consumption and Energy Intensity in Residential Buildings by Size of Building, 1980 and 1990



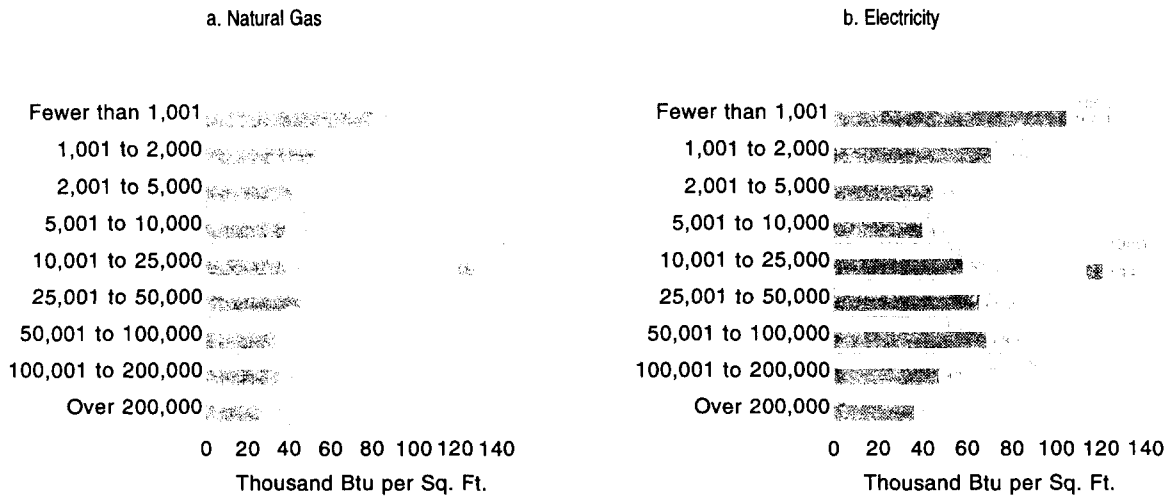
Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1980 and 1990 Residential Energy Consumption Surveys.

Figure 4.18. Primary Energy Consumption and Energy Intensity in Commercial Buildings by Size of Building, 1979 and 1989



Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-143 of the 1979 Nonresidential Buildings Energy Consumption Survey and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

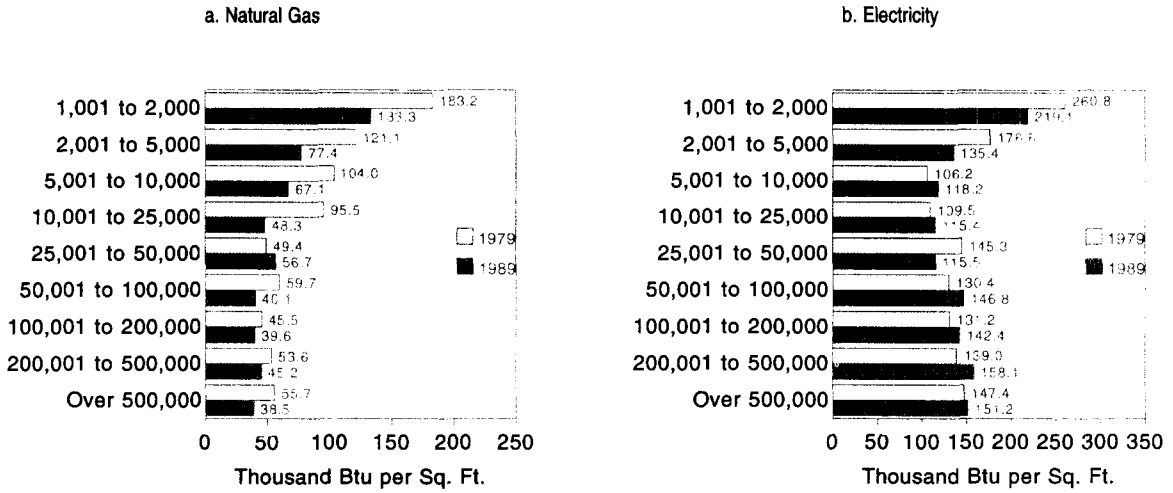
Figure 4.19. Natural Gas and Electricity Energy Intensity in Residential Buildings by Size of Building, 1980 and 1990



Q = Data withheld either because the Relative Standard Error was greater than 50 percent or fewer than 10 households were sampled.

Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1980 and 1990 Residential Energy Consumption Surveys.

Figure 4.20. Natural Gas and Electricity Energy Intensity in Commercial Buildings by Size of Building, 1979 and 1989



Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-143 of the 1979 Nonresidential Buildings Energy Consumption Survey and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

Census Region

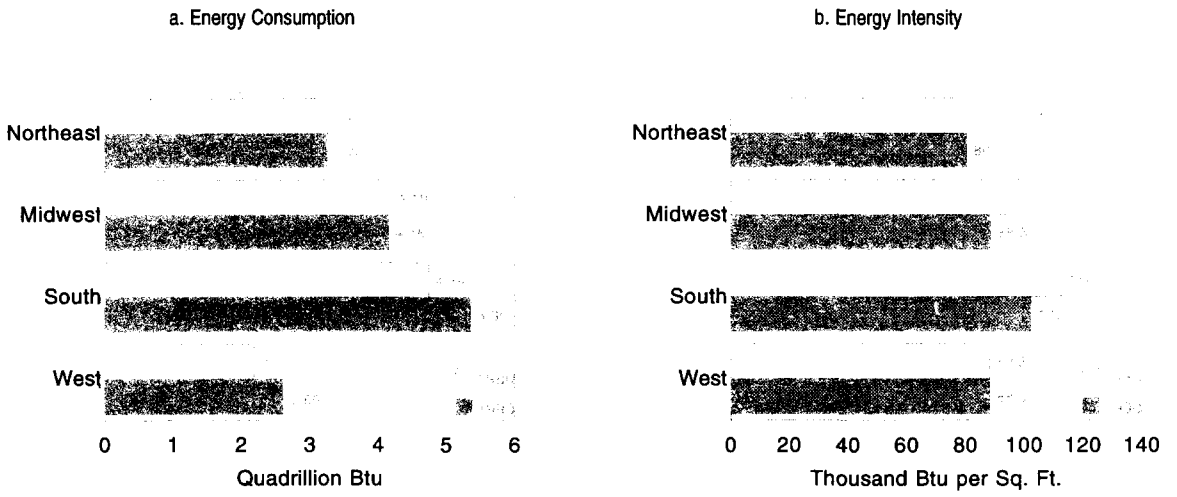
Similar patterns of regional variation occurred for both residential and commercial consumption and intensity. The share of consumption in residential and commercial buildings was greatest in the South (Figure 4.21a and 4.22a). This was due to the presence of a greater number of people (hence, number of residences and more commercial activity) in the South.

Natural gas intensities were greatest in both residential and commercial buildings in the Midwest (Figures 4.23a and 4.24a). In residential buildings, electricity intensities were highest in the South; in commercial buildings, they were highest in the West (Figures 4.23b and 4.24b).

In the 1980's:

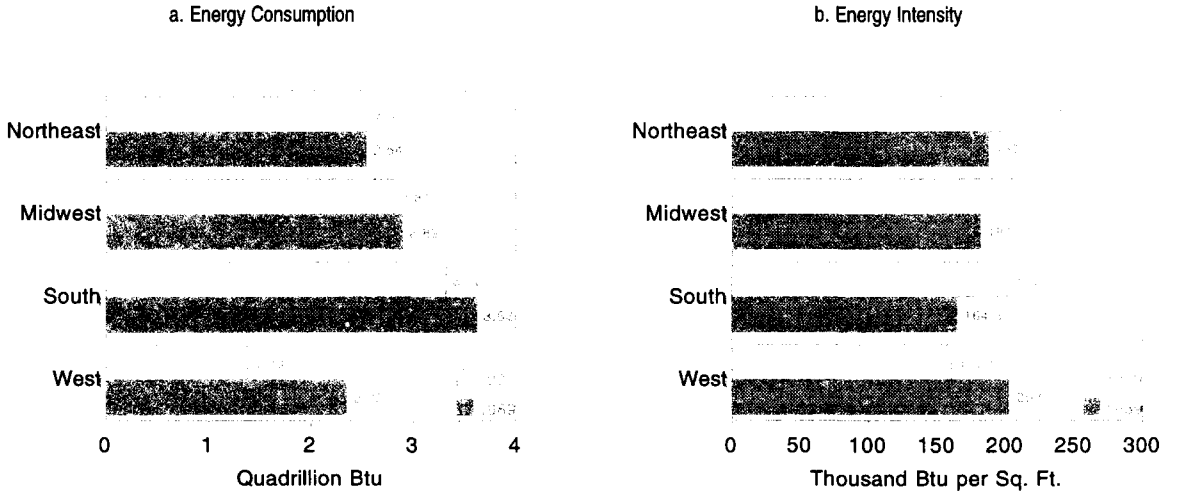
- Residential energy intensities declined in every region except in the West, where there was no change (Figure 4.21b).
- Commercial consumption showed one change, an increase in the West (Figure 4.22a).
- Commercial buildings intensities declined in the Midwest, South, and Northeast but increased in the West (Figure 4.22b).
- With the exception of residential buildings in the West, natural gas intensities declined in all regions in both sectors (Figures 4.23a and 4.24a).
- Electricity intensities increased in the West in commercial buildings; otherwise, they were unchanged in all other regions in both sectors (Figures 4.23b and 4.24b).

Figure 4.21. Primary Energy Consumption and Energy Intensity in Residential Buildings by Census Region, 1980 and 1990



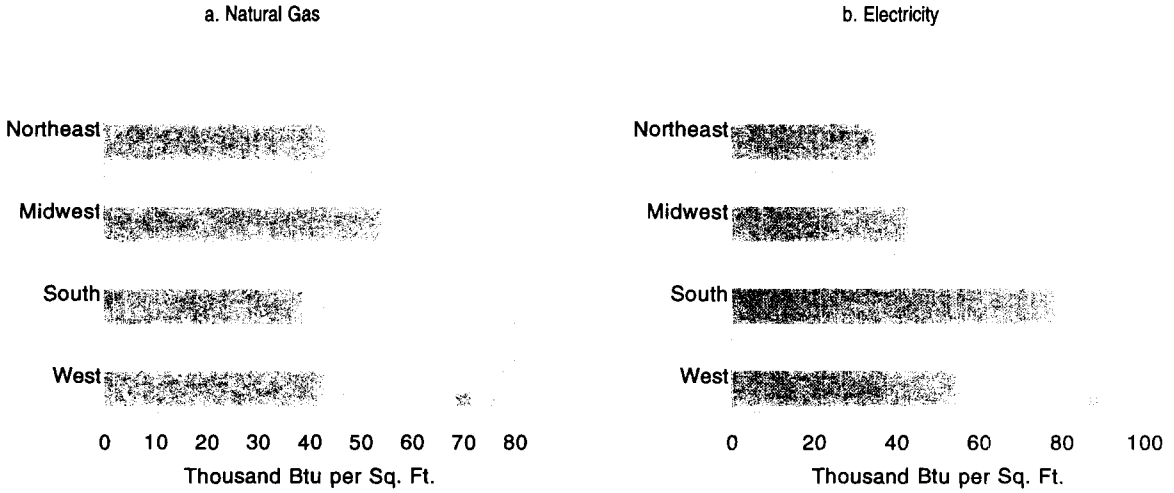
Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1980 and 1990 Residential Energy Consumption Surveys.

Figure 4.22. Primary Energy Consumption and Energy Intensity in Commercial Buildings by Census Region, 1979 and 1989



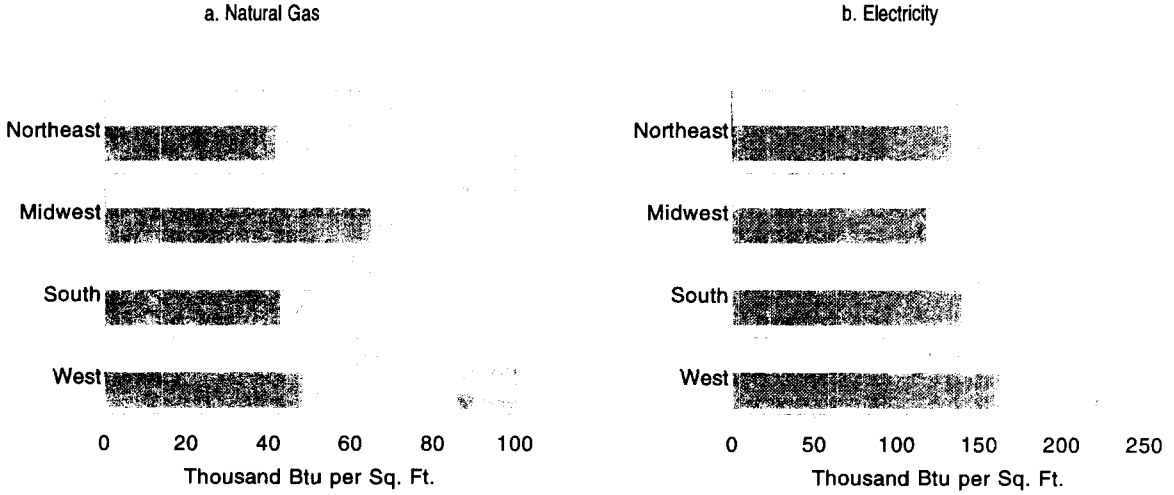
Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-143 of the 1979 Nonresidential Buildings Energy Consumption Survey and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

Figure 4.23. Natural Gas and Electricity Energy Intensity in Residential Buildings by Census Region, 1980 and 1990



Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1980 and 1990 Residential Energy Consumption Surveys.

Figure 4.24. Natural Gas and Electricity Energy Intensity in Commercial Buildings by Census Region, 1979 and 1989



Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-143 of the 1979 Nonresidential Buildings Energy Consumption Survey and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

Year Constructed

In the 1990 survey, the energy intensities of residential buildings constructed in the 1980's were lower than those built during the preceding decades. This is a preview of the future, when buildings constructed after 1980 will constitute a larger share of the building stock and, thus, lower energy intensities can be expected.

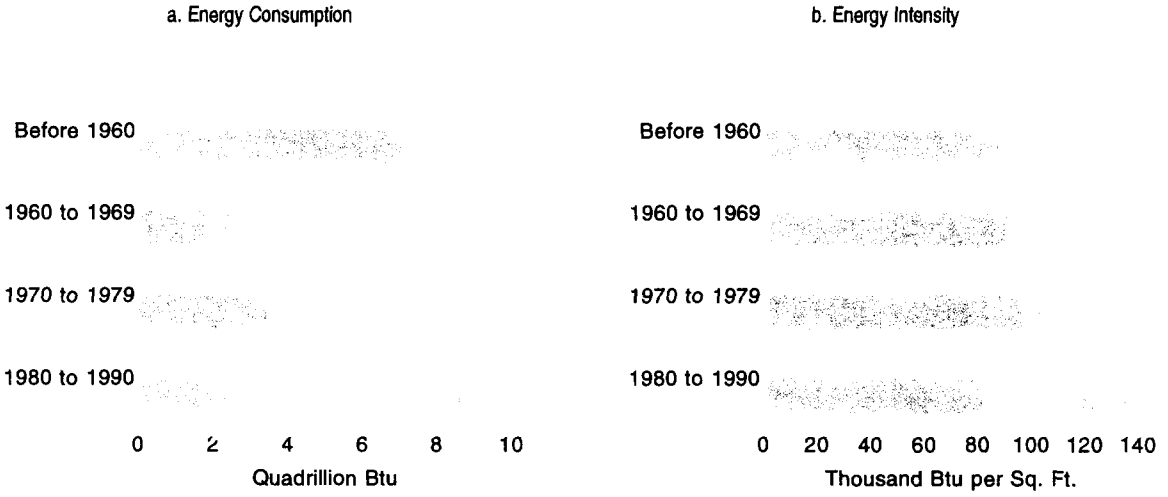
At the end of the 1980's, more than half of residential energy and more than a third of commercial energy was consumed in buildings constructed before 1960 (Figures 4.25a and 4.26a). In contrast, just under half of residential buildings and floorspace and about 40 percent of commercial buildings and floorspace were constructed before 1960.

Energy intensities were at similar levels across year-constructed categories in the residential sector for the 1980 residential survey. In the 1989 commercial buildings survey, the energy intensities of most recently constructed buildings exceeded those constructed before 1960 (Figure 4.25b). This reflected the increased demand for electricity consumption in the most recently constructed buildings.

In the 1980's:

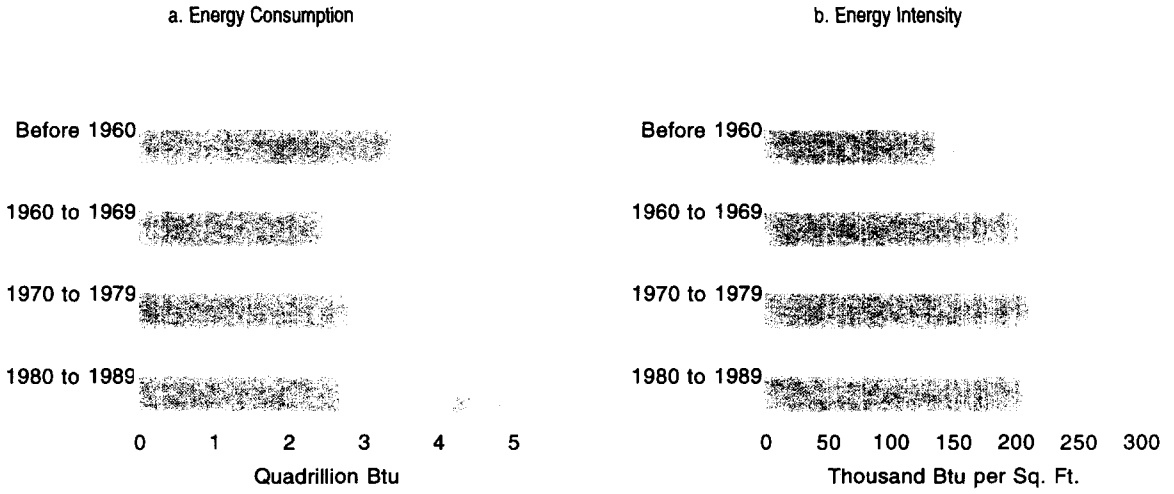
- Energy intensity in commercial buildings constructed in the 1970's, 1960's, and before 1960 all declined (Figure 4.25b).
- Natural gas intensities generally declined by 10 to 30 percent across the year-constructed categories in both sectors, while electricity intensities showed no change (Figures 4.27a and b and 4.28a and b).

Figure 4.25. Primary Energy Consumption and Energy Intensity in Residential Buildings by Year Constructed, 1980 and 1990



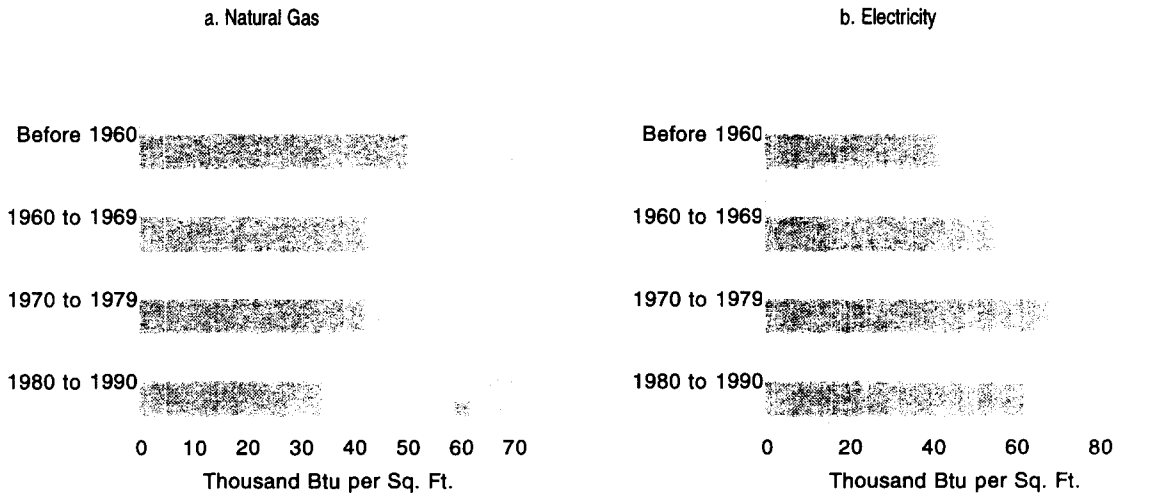
Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1980 and 1990 Residential Energy Consumption Surveys.

Figure 4.26. Primary Energy Consumption and Energy Intensity in Commercial Buildings by Year Constructed, 1979 and 1989



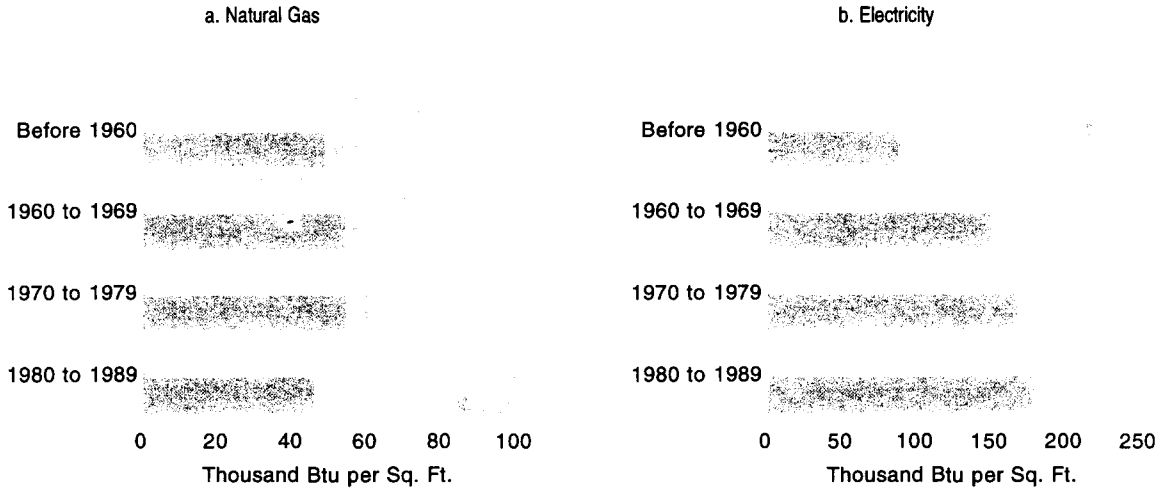
Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-143 of the 1979 Nonresidential Buildings Energy Consumption Survey and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

Figure 4.27. Natural Gas and Electricity Energy Intensity in Residential Buildings by Year Constructed, 1980 and 1990



Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1980 and 1990 Residential Energy Consumption Surveys.

Figure 4.28. Natural Gas and Electricity Energy Intensity in Commercial Buildings by Year Constructed, 1979 and 1989



Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-143 of the 1979 Nonresidential Buildings Energy Consumption Survey and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

Table 4.1. Total Primary Consumption for All End Uses by Major Energy Source in Residential Buildings (quadrillion Btu)

Year of Survey	Energy Sources							
	All Major Sources	Electricity	Natural Gas	Fuel Oil and Kerosene*	Fuel Oil	Kerosene	LPG	
RSE Column Factors:	0.3	0.4	0.7	1.1	1.3	3.4	2.8	RSE Row Factors
1980	14.382	7.541	4.967	1.524	--	--	0.349	4.6
1981	14.283	7.414	5.273	1.281	--	--	0.314	4.7
1982	13.417	7.187	4.743	1.196	--	--	0.290	5.2
1984	14.154	7.599	4.984	1.256	1.154	0.102	0.315	4.5
1987	14.790	8.419	4.832	1.224	1.135	0.089	0.315	4.4
1990	15.368	9.182	4.863	1.041	0.976	0.065	0.281	4.6

*Fuel oil and kerosene were combined in the 1980, 1981, and 1982 surveys.

Notes: • To obtain the Relative Standard Error (RSE) percentage for any table cell, multiply the corresponding RSE column factor by the corresponding RSE row factor for the cell. • See "Glossary" for definition of terms used in this report.

Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1980, 1981, 1982, 1984, 1987, and 1990 Residential Energy Consumption Surveys.

Table 4.2. Energy Intensities for All End Uses by Major Energy Source in Residential Buildings (thousand Btu per square foot)

Year of Survey	Energy Sources							
	All Major Sources	Electricity	Natural Gas	Fuel Oil and Kerosene*	Fuel Oil	Kerosene	LPG	
RSE Column Factors:	0.4	0.6	0.5	1.0	1.0	4.3	2.1	RSE Row Factors
1980	100.93	52.93	56.12	51.31	--	--	28.77	3.2
1981	99.05	51.42	56.84	44.38	--	--	25.87	3.3
1982	94.32	50.54	51.64	39.83	--	--	24.73	3.7
1984	98.05	52.67	53.50	39.25	49.47	9.10	26.24	3.0
1987	94.31	53.70	48.63	36.76	45.81	8.14	25.67	3.3
1990	90.81	54.27	45.74	31.36	38.46	7.01	20.24	3.7

*Fuel oil and kerosene were combined in the 1980, 1981, and 1982 surveys.

Notes: • To obtain the Relative Standard Error (RSE) percentage for any table cell, multiply the corresponding RSE column factor by the corresponding RSE row factor for the cell. • See "Glossary" for definition of terms used in this report.

Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1980, 1981, 1982, 1984, 1987, and 1990 Residential Energy Consumption Surveys.

Table 4.3. Total Primary Consumption for All End Uses by Major Energy Source in Commercial Buildings (quadrillion Btu)

Year of Survey	Energy Sources					
	All Major Sources	Electricity	Natural Gas	Fuel Oil[a]	District Heat	
RSE Column Factors:	0.7	0.8	1.1	1.6	2.2	RSE Row Factors
1979	8.847	5.790	2.174	0.681	0.201	11.0
1979, adjusted[b]	10.159	6.649	2.497	0.782	0.231	NF
1983	9.257	6.564	2.091	0.314	0.289	10.0
1986	9.906	7.319	1.723	0.442	0.422	7.8
1989	11.401	8.386	2.073	0.357	0.585	8.6

[a]Includes kerosene.
[b]1979 consumption adjusted by applying 1979 consumption intensity to adjusted floorspace. See Appendix C, "Data Quality", for further discussion.
NF = No applicable RSE row/column factor.
Notes: • To obtain the Relative Standard Error (RSE) percentage for any table cell, multiply the corresponding RSE column factor by the corresponding RSE row factor for the cell. • See "Glossary" for definition of terms used in this report.
Sources: Energy Information Administration, Office of Energy Markets and End Use, Forms EIA-143, 788, and 871 of the 1979, 1983, and 1986 Nonresidential Buildings Energy Consumption Surveys and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

Table 4.4. Energy Intensities for All End Uses by Major Energy Source in Commercial Buildings (thousand Btu per square foot)

Year of Survey	Energy Sources					
	All Major Sources	Electricity	Natural Gas	Fuel Oil*	District Heat	
RSE Column Factors:	0.7	0.9	1.2	1.4	1.9	RSE Row Factors
1979	203.16	134.18	71.35	59.73	54.04	7.0
1983	187.13	135.82	61.61	33.42	64.79	9.5
1986	170.21	129.53	46.23	40.14	91.24	6.5
1989	180.44	136.21	50.39	28.32	88.96	7.0

*Includes kerosene.
Notes: • To obtain the Relative Standard Error (RSE) percentage for any table cell, multiply the corresponding RSE column factor by the corresponding RSE row factor for the cell. • See "Glossary" for definition of terms used in this report.
Sources: Energy Information Administration, Office of Energy Markets and End Use, Forms EIA-143, 788, and 871 of the 1979, 1983, and 1986 Nonresidential Buildings Energy Consumption Surveys and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

Table 4.5. Total Primary Consumption by End Use in Residential Buildings (quadrillion Btu)

Year of Survey	End Uses					
	All End Uses	Space Heating	Water Heating	Air Conditioning	Appliances	
RSE Column Factors:	1.0	NF	NF	NF	NF	RSE Row Factors
1980	14.382	5.907	2.366	1.132	4.977	1.1
1981	14.283	5.887	2.334	1.070	4.991	1.4
1982	13.417	5.294	2.220	1.049	4.854	1.4
1984	14.154	5.747	2.292	1.047	5.068	1.2
1987	14.790	5.522	2.284	1.345	5.639	1.0
1990	15.368	5.404	2.356	1.467	6.141	1.0

NF = No applicable RSE row/column factor.

Notes: • To obtain the Relative Standard Error (RSE) percentage for any table cell, multiply the corresponding RSE column factor by the corresponding RSE row factor for the cell. • See "Glossary" for definition of terms used in this report.

Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1980, 1981, 1982, 1984, 1987, and 1990 Residential Energy Consumption Surveys.

Table 4.6. Energy Intensities by End Use in Residential Buildings (thousand Btu per square foot)

Year of Survey	End Uses					
	All End Uses	Space Heating	Water Heating	Air Conditioning	Appliances	
RSE Column Factors:	1.0	NF	NF	NF	NF	RSE Row Factors
1980	100.94	42.64	16.71	14.08	34.93	1.2
1981	99.06	42.30	16.28	12.72	34.61	1.3
1982	94.33	38.39	15.71	12.45	34.13	1.3
1984	98.05	40.91	16.02	11.75	35.11	1.1
1987	94.31	36.04	14.64	13.59	35.96	1.2
1990	90.81	32.41	13.97	12.94	36.29	1.4

NF = No applicable RSE row/column factor.

Notes: • To obtain the Relative Standard Error (RSE) percentage for any table cell, multiply the corresponding RSE column factor by the corresponding RSE row factor for the cell. • See "Glossary" for definition of terms used in this report.

Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1980, 1981, 1982, 1984, 1987, and 1990 Residential Energy Consumption Surveys.

Table 4.7. Total Primary Consumption by Major Energy Sources and End Uses in Residential Buildings (quadrillion Btu)

Year of Survey	Energy Sources									
	Electricity				Natural Gas			Fuel Oil	Kerosene	Fuel Oil and Kerosene*
	Space Heating	Water Heating	Appliances	Air Conditioning	Space Heating	Water Heating	Appliances	Space Heating	Space Heating	Space Heating
1980	0.960	0.925	4.565	1.091	3.411	1.152	0.365	--	--	1.305
1981	0.922	0.928	4.515	1.049	3.692	1.133	0.427	--	--	1.063
1982	0.919	0.865	4.379	1.024	3.144	1.148	0.427	--	--	1.045
1984	0.917	0.991	4.676	1.015	3.509	1.095	0.347	1.006	0.101	--
1987	0.863	0.961	5.263	1.332	3.382	1.100	0.337	0.966	0.088	--
1990	0.918	1.027	5.782	1.457	3.367	1.160	0.326	0.866	0.065	--

*Fuel oil and kerosene were combined in the 1980, 1981, and 1982 surveys.

Notes: • See "Glossary" for definition of terms used in this report. • No applicable Relative Standard Error (RSE) row/column factors for end-use estimates.

Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1980, 1981, 1982, 1984,1987, and 1990 Residential Energy Consumption Surveys.

Table 4.8. Total Primary Consumption by Major Energy Sources and End Uses in Commercial Buildings (quadrillion Btu)

Year of Survey	Energy Sources								
	Electricity					Natural Gas		District Heat	Fuel Oil
	Lighting	Cooling	Ventilation	Space Heating	Water Heating	Space Heating	Water Heating	Space Heating	Space Heating
1989	3.094	0.853	0.841	0.290	0.073	1.265	0.320	0.355	0.301

Notes: • See "Glossary" for definition of terms used in this report. • No applicable Relative Standard Error (RSE) row/column factors for end-use estimates.

Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey, and *Energy End-Use Intensities in Commercial Buildings,* DOE/EIA-0555(94)/2.

Table 4.9a. Total Expenditures for All End Uses by Major Energy Source in Residential Buildings (billion dollars)

Year of Survey	Energy Sources								RSE Row Factors
	All Major Sources		Electricity		Natural Gas		Fuel Oil and Kerosene		
	1987 Dollars	Current Dollars	1987 Dollars	Current Dollars	1987 Dollars	Current Dollars	1987 Dollars	Current Dollars	
RSE Column Factors:	0.5	0.5	0.7	0.7	1.3	1.3	2.2	2.2	
1980	102.735	75.613	55.446	40.808	26.860	19.769	16.630	12.239	2.6
1981	103.512	83.016	55.855	44.796	29.959	24.027	14.199	11.387	2.5
1982	102.034	86.525	55.116	46.739	31.798	26.964	11.879	10.074	2.7
1984	106.795	96.970	59.999	54.479	32.793	29.776	10.571	9.598	2.4
1987	97.747	97.747	61.580	61.580	26.149	26.149	7.208	7.208	2.4
1990	96.994	110.185	62.972	71.537	23.998	27.261	7.260	8.247	2.4

Notes: • To obtain the Relative Standard Error (RSE) percentage for any table cell, multiply the corresponding RSE column factor by the corresponding RSE row factor for the cell. • See "Glossary" for definition of terms used in this report.

Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1980, 1981, 1982, 1984, 1987, and 1990 Residential Energy Consumption Surveys.

Table 4.9b. Total Expenditures for All End Uses by Major Energy Source in Commercial Buildings (billion dollars)

Year of Survey	Energy Sources								RSE Row Factors
	All Major Sources		Electricity		Natural Gas		Fuel Oil		
	1987 Dollars	Current Dollars	1987 Dollars	Current Dollars	1987 Dollars	Current Dollars	1987 Dollars	Current Dollars	
RSE Column Factors:	0.8	0.8	0.9	0.9	1.0	1.0	1.4	1.4	
1979	50.444	33.596	35.662	23.751	8.730	5.814	4.152	2.765	8.7
1979, adjusted*	57.812	38.503	40.922	27.254	9.984	6.649	4.716	3.141	NF
1983	63.156	55.451	44.737	39.279	13.033	11.443	2.394	2.102	8.4
1986	62.339	60.219	48.847	47.186	8.649	8.355	2.132	2.059	5.4
1989	65.217	70.826	51.513	55.943	8.475	9.204	1.678	1.822	6.2

*1979 expenditures adjusted by applying 1979 expenditure intensity to adjusted 1979 floorspace. See Appendix C, "Data Quality", for further discussion.

NF = No applicable RSE row/column factor.

Notes: • To obtain the Relative Standard Error (RSE) percentage for any table cell, multiply the corresponding RSE column factor by the corresponding RSE row factor for the cell. • See "Glossary" for definition of terms used in this report.

Sources: Energy Information Administration, Office of Energy Markets and End Use, Forms EIA-143,788, and 871 of the 1979, 1983, and 1986 Nonresidential Buildings Energy Consumption Surveys and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

Table 4.10. Total Expenditures by End Use in Residential Buildings (billion dollars)

Year of Survey	End Uses							
	Space Heating		Water Heating		Air Conditioning		Appliances	
	1987 Dollars	Current Dollars	1987 Dollars	Current Dollars	1987 Dollars	Current Dollars	1987 Dollars	Current Dollars
1980	40.709	29.962	15.323	11.278	8.182	6.022	38.520	28.351
1981	40.605	32.565	15.604	12.514	8.024	6.435	39.281	31.503
1982	39.408	33.418	15.715	13.326	8.044	6.821	38.868	32.960
1984	32.380	36.881	16.229	14.736	8.307	7.543	41.642	37.811
1987	31.682	31.682	13.910	13.910	9.829	9.829	42.326	42.326
1990	30.079	34.170	13.445	15.274	9.932	11.283	43.537	49.458

Notes: • See "Glossary" for definition of terms used in this report. • No applicable Relative Standard Error (RSE) row/column factors for end-use estimates.

Sources: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1980, 1981, 1982, 1984, 1987, and 1990 Residential Energy Consumption Surveys.

Table 4.11 Total Primary Consumption and Energy Intensities in Residential Buildings, 1980 and 1990

Building Characteristics	Total Consumption (quadrillion Btu)		Energy Intensities (thousand Btu per sq. ft.)						RSE Row Factors
			All Major Sources		Electricity		Natural Gas		
	1980	1990	1980	1990	1980	1990	1980	1990	
RSE Column Factors:	1.1	1.2	0.7	0.7	1.1	1.1	1.1	1.1	
All Buildings	14.382	15.368	100.93	90.81	52.93	54.27	56.12	45.74	1.5
Census Region									
Northeast	3.273	3.246	93.91	80.45	35.44	35.07	50.12	43.81	2.8
Midwest	4.190	4.153	102.70	88.48	44.81	42.82	69.63	54.22	2.6
South	4.741	5.364	112.39	102.30	76.65	78.63	53.27	38.70	3.1
West	2.178	2.605	88.30	88.28	50.49	55.42	44.48	42.91	3.0
Census Division									
New England	0.777	0.728	87.68	78.38	33.98	33.87	47.11	44.95	5.0
Middle Atlantic	2.496	2.517	96.03	81.07	35.93	35.43	50.71	43.61	3.6
East North Central	2.945	2.997	105.96	88.77	44.59	42.08	74.67	56.13	3.6
West North Central	1.245	1.157	95.73	87.75	45.29	44.71	58.89	49.48	4.1
South Atlantic	2.342	2.560	105.09	96.20	71.52	76.61	51.48	37.65	4.5
East South Central	0.971	1.090	113.43	101.19	86.08	77.90	55.34	37.64	7.9
West South Central	1.428	1.714	125.96	113.85	79.63	82.72	54.06	40.15	5.0
Mountain	0.649	0.781	102.43	99.88	51.44	54.93	60.61	55.62	5.6
Pacific	1.529	1.824	83.42	84.10	50.18	55.60	39.12	37.96	3.6
Type of Home									
Mobile Home	0.678	0.735	178.30	150.07	116.20	99.98	97.49	78.33	5.6
Single-Family Detached	10.448	11.071	92.51	85.60	50.36	50.86	53.22	42.14	1.9
Single-Family Attached	0.559	0.906	92.00	90.52	40.34	57.04	43.60	45.88	7.4
2 to 4 Units	1.468	1.352	136.08	114.77	48.77	51.65	85.21	68.75	4.5
5 or More Units	1.228	1.304	138.04	111.63	72.04	73.50	50.43	48.83	5.0
Building Floorspace (square feet)									
Fewer than 1,001	1.426	1.331	183.06	160.36	105.70	106.42	104.83	80.56	3.7
1,001 to 2,000	4.562	4.636	122.60	112.55	69.14	70.93	66.82	55.07	2.4
2,001 to 5,000	6.736	7.508	85.00	77.97	41.97	44.40	50.49	41.59	2.0
5,001 to 10,000	0.854	1.065	72.48	73.60	36.71	40.03	41.79	38.22	6.4
10,001 to 25,000	0.348	0.385	105.69	86.66	52.82	57.84	44.23	38.37	13.3
25,001 to 50,000	0.164	0.126	156.83	110.87	69.98	65.32	54.65	46.24	13.3
50,001 to 100,000	0.127	0.188	139.39	97.61	51.69	68.44	25.61	33.59	15.6
100,001 to 200,000	0.106	0.077	138.39	94.38	82.65	47.11	18.58	35.29	22.9
Over 200,000	0.058	0.053	130.50	78.22	66.71	36.09	Q	27.34	27.7
Year Constructed									
1939 or Before	4.136	3.607	95.55	88.49	35.38	38.01	59.01	53.07	2.8
1940 to 1949	1.280	1.129	107.89	97.36	48.73	50.09	60.94	50.95	4.2
1950 to 1959	2.465	2.297	104.00	93.03	49.83	50.32	58.41	46.05	3.5
1960 to 1969	2.700	2.386	103.01	91.12	56.82	55.51	55.40	43.19	3.6
1970 to 1979	3.525	3.495	102.71	96.34	74.47	68.71	48.00	42.55	3.4
1980 to 1990	0.276	2.454	88.61	82.60	66.14	62.75	37.80	34.30	7.0

Q = Data withheld either because the Relative Standard Error (RSE) was greater than 50 percent or fewer than 10 households were sampled.

Notes: • To obtain the RSE percentage for any table cell, multiply the corresponding RSE column factor by the corresponding RSE row factor for the cell. • Because of rounding, data may not sum to totals. • See "Glossary" for definition of terms used in this report.

Source: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-457 of the 1980 and 1990 Residential Energy Consumption Survey.

Table 4.12. Total Primary Consumption and Energy Intensities in Commercial Buildings, 1979 and 1989

Building Characteristics	Total Consumption (quadrillion Btu)			Energy Intensities (thousand Btu per square foot)						RSE Row Factors
				All Major Sources		Electricity		Natural Gas		
	1979	1979 (adjusted)*	1989	1979	1989	1979	1989	1979	1979	
RSE Column Factors:	0.9	NF	1.0	0.9	0.8	1.2	0.9	1.2	1.1	
All Buildings	8.847	10.159	11.401	203.16	180.44	134.18	136.21	71.35	50.39	5.7
Census Region										
Northeast	2.082	2.553	2.540	218.46	187.18	136.49	132.89	65.64	41.46	11.9
Midwest	3.033	2.808	2.892	213.66	181.25	127.14	117.26	85.25	64.84	8.6
South	2.742	3.322	3.621	200.74	164.31	149.68	138.94	60.46	42.68	9.3
West	0.989	1.385	2.348	160.61	202.04	112.89	161.31	61.47	48.01	12.1
Principal Building Activity										
Assembly	0.702	.791	0.818	131.67	118.32	76.42	82.20	53.50	40.37	13.1
Education	0.842	1.056	1.143	141.11	141.51	82.80	81.22	51.29	48.72	10.5
Food Sales and Service	0.685	0.623	0.835	387.03	426.32	294.48	336.51	127.16	113.62	10.1
Health Care	0.730	0.651	0.761	373.42	370.31	199.68	226.56	127.03	116.34	10.4
Lodging	0.520	0.667	0.705	250.88	202.73	174.00	120.01	75.52	73.73	13.6
Mercantile and Service	1.627	1.614	2.161	163.37	174.75	110.26	134.48	55.85	47.40	10.1
Office	1.723	1.977	2.811	246.56	238.20	184.17	200.33	59.05	32.97	7.1
Warehouse	1.093	1.280	1.027	181.90	110.98	113.30	82.95	83.90	40.20	16.4
Other	0.764	0.695	0.964	358.38	308.14	217.30	239.60	166.55	82.74	24.7
Vacant	0.161	0.427	0.177	117.75	42.58	95.75	39.16	47.39	Q	24.3
Building Floorspace (square feet)										
1,001 to 2,000	0.288	0.459	0.415	366.97	270.38	260.78	219.06	183.21	133.25	8.5
2,001 to 5,000	0.888	1.153	0.936	264.50	178.07	176.61	135.36	121.09	77.38	7.3
5,001 to 10,000	0.950	0.979	1.065	187.35	163.12	106.22	118.23	104.03	67.09	10.9
10,001 to 25,000	1.463	1.547	1.562	190.86	150.31	109.52	115.37	95.52	48.31	9.6
25,001 to 50,000	1.322	1.370	1.426	195.00	162.07	145.26	115.49	49.40	56.69	10.2
50,001 to 100,000	1.191	1.301	1.731	184.75	189.64	130.37	146.83	59.74	40.06	12.9
100,001 to 200,000	1.083	1.312	1.561	194.82	188.57	131.20	142.41	45.45	39.57	13.5
200,001 to 500,000	1.077	1.150	1.438	208.38	204.82	139.02	158.12	53.63	45.17	14.3
Over 500,000	0.584	1.021	1.266	215.40	202.84	147.41	151.20	55.74	38.50	16.8
Year Constructed										
1899 or Before	0.362	0.299	0.178	181.07	107.67	115.01	48.03	59.74	52.31	15.4
1900 to 1919	0.623	0.568	0.391	133.74	92.20	72.27	58.97	50.21	40.22	16.9
1920 to 1945	1.684	1.574	1.062	194.42	131.18	104.85	80.88	93.31	42.46	14.8
1946 to 1959	1.569	1.966	1.754	187.00	166.91	117.62	112.41	64.01	56.77	10.9
1960 to 1969	2.053	2.668	2.467	219.31	202.76	152.00	149.38	65.97	54.05	9.5
1970 to 1979	2.556	3.252	2.820	243.97	211.57	186.91	167.66	77.47	54.41	7.4
1980 to 1989	--	--	2.728	--	206.97	--	178.02	--	45.73	8.7

*1979 consumption adjusted by applying 1979 consumption intensity to adjusted 1979 floorspace. See Appendix C, "Data Quality", for further discussion.

Q = Data withheld because the Relative Standard Error (RSE) was greater than 50 percent or fewer than 20 buildings were sampled.

Notes: To obtain the RSE percentage for any table cell, multiply the corresponding RSE column factor by the corresponding RSE row factor for the cell. • See "Glossary" for definition of terms used in this report.

Source: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-143 of the 1979 Nonresidential Buildings Energy Consumption Survey and Form EIA-871 of the 1989 Commercial Buildings Energy Consumption Survey.

Appendix A

Detailed Tables

This report introduces several innovations in energy data reporting that complement the previously published triennial reports of the Residential Energy Consumption Survey (RECS) and the Commercial Buildings Energy Consumption Survey (CBECS). (1) Both residential and commercial sector buildings data are presented together in the report. Common units of analysis, the residential or commercial building and floorspace, are used to facilitate comparison.[17] (2) Unlike the triennial RECS and CBECS that focus on energy data for a single year, this report focuses on an entire decade of energy data. (3) A common set of table types is used to provide consistency across the sectors and across time. (4) Energy expenditures are reported in both nominal and real terms. (5) End-use consumption and expenditures are provided for the earlier RECS, data that were not published in the original *Consumption and Expenditures* reports. (6) Primary energy consumption is reported for all energy consumption estimates.

Table Format

The Energy Information Administration (EIA) is responsible for publishing national-level statistics on energy consumption by end users. Currently, the EIA publishes statistics for the residential, residential transportation (personal vehicles), commercial buildings, and manufacturing sectors. For the commercial sector, data are collected via a nationwide survey of commercial buildings, the CBECS. The RECS collects data from the households in the residential sector. This report summarizes a decade of energy data that were obtained via the RECS and CBECS, using data from the six RECS and the four CBECS, which were conducted between 1979 and 1990.

The RECS and CBECS data bases for the ten surveys over the 1979 to 1990 time frame contain an enormous amount of information on buildings and energy. A major consideration in the preparation of this report was how to limit these data to a manageable size. The detailed tables were designed to provide, as much as possible, information that is consistent between the two sectors and across the time period covered. The format of the tables was geared towards answering four general energy-related questions: (1) How many buildings used each possible energy source/end-use combination? (2) How much floorspace was in buildings which used each possible energy source/end use combination? (3) How much energy was consumed? and (4) How much money was spent on energy?

For a given table, the row-stub categories address information on several major building characteristics that are common to both surveys: location, type of building, size, and year of construction. There are eight types of tables: three types provide data on the number of buildings and the total floorspace by energy source and end use; two types provide data on energy consumption by energy source and end use; two types provide similar data for energy expenditures; and one type provides total and average consumption and expenditures by energy source. A given table or set of tables can provide information on energy use between the residential and commercial sectors or on energy use within a sector over the decade either among energy sources or end uses.

[17]For further information concerning the development of the common units of analysis, see Appendix C, "Data Quality."

Appendix B

How the Surveys Were Conducted

The RECS and CBECS reports differ in some ways from survey year to survey year: sample sizes fluctuate, target populations change, data questionnaires are reworded, and data collection methods vary slightly. Both the RECS and CBECS reports are products of an evolving process of data collection designed to meet the needs of our customers at that particular time and to eliminate difficulties encountered in past surveys. This appendix briefly describes the survey methodologies of the RECS and CBECS, as well as sampling and nonsampling errors and response rates.

Survey Methodologies

The RECS and the CBECS were designed to collect data on energy consumption, energy expenditures, and energy-related characteristics of residential and commercial buildings. The surveys are conducted in two stages: (1) A Household (RECS)/Building (CBECS) Survey and an Energy Suppliers Survey. The Household/Building Characteristics Survey consists of personal interviews with knowledgeable respondents at each sample household/building. The only exception occurred in 1983, when the CBECS was conducted by Computer Assisted Telephone Interview (CATI). The interview covered topics such as physical characteristics of the structure, occupancy patterns, major equipment, conservation practices, and the types and uses of energy in the structure.

At the end of the interview, respondents were asked to provide the names and addresses of the companies that supply energy to their household/building in the form of electricity, natural gas, fuel oil, or district heating and cooling (CBECS only), and to sign a form authorizing the EIA to collect billing information directly from these energy supply companies. A separate mail survey, the Energy Suppliers Survey, asks these energy suppliers to provide data on the amounts and costs of energy delivered to the household/building during the survey year.

Tables B1 and B2 are provided for readers to compare the RECS and the CBECS survey samples and designs over the decade as well as response rates associated with each survey year. For a discussion on the individual surveys, see the appendices of previous publications of the RECS and CBECS.[18]

Table B1. RECS Survey Sample and Design, 1980 to 1990

Survey Sample	1980	1981	1982	1984	1987	1990
Sample Size						
Total Units	7,232	7,550	5,808	7,535	8,007	6,607
Eligible Units	6,634	6,841	5,272	6,752	7,183	5,909
Interviews Completed	6,051	6,269	4,724	5,682	6,229	5,095
Response Rates	91.2%	91.6%	89.6%	84.2%	86.7%	86.2%
Data Collection						
Target Population	Housing Units*	Same as 1980	Same as 1980	Same as 1980	Same as 1980	Same as 1980
Collection Instrument	Personal Interview	Same as 1980	Same as 1980	Same as 1980	Same as 1980	Same as 1980

*For the definition of Housing Unit, see Appendix E, "Glossary."

[18]See Appendix E, "Related EIA Energy Consumption Publications."

Table B2. CBECS Survey Sample and Design, 1979 to 1989

Survey Sample and Design	1979	1983	1986	1989
Sample Size				
Total Units	7,322	8,479	9,189	8,791
Eligible Units	6,773	8,018	7,539	6,352
Interviews Completed	6,222	7,140	7,024	5,877
Response Rate	91.8%	89.1%	93.2%	92.5%
Data Collection				
Target Population	Subset of nonresidential buildings, excluding those in which industrial or agricultural activities occupy more of the total floorspace than any other type of activity	Same as 1979	Buildings used primarily for commercial purpose 1,001 square feet or more - buildings 1,000 square feet or less were excluded from the published estimates	Same as in 1986 - interviews were not conducted at buildings 1,000 square feet or less
Collection Instrument	Personal Interview	Computer Assisted Telephone Interview (CATI)	Personal Interview	Same as 1986

Nonsampling and Sampling Errors

Nonsampling errors are the set of all errors in surveys that arise from anything other than the sampling process. Because these errors occur outside the sampling process, they are equally likely to occur in a complete census or a sample survey. Nonsampling errors include: (1) operational errors, including editing, coding, and tabulation errors; (2) errors of measurement, including a lack of precision by the respondent and failure of the respondent to understand instruction; (3) errors of estimation, including the assumptions underlying the derived values; and (4) errors of nonobservation, including nonresponse and noncoverage. Some nonsampling errors are random, some are not. Random nonsampling errors tend to cancel out the set of all possible samples; however, these errors do affect estimates in a given survey. Biased nonsampling error occurs when some systematic error occurs, such as an interviewer consistently re-wording a question and thereby changing the question's meaning and biasing the response. Biased nonsampling error, when present, will affect the estimates regardless of the specific sample chosen. There is no measure for errors that occur outside of the sampling process.

Sampling errors occur because the CBECS and RECS samples represent only one of the possible samples that could be selected under the same survey specifications. The estimated values are developed from one of many possible samples that could be drawn and, therefore, will differ from true population values that would be obtained from a complete enumeration. Each possible sample yields its own estimates of the true population values, with the differences attributable to the particular set of cases selected in each sample.

One measure of the variability caused by the sampling process is the average magnitude between the values for the population of all samples and the true population value. This measure is the difference one would expect to obtain between a given estimate and the true value, based on the mean difference from the true value over all possible samples. In other words, sampling error is a measure of the variability of all samples, one of which was drawn. This measure accounts only for random sampling error. Biased sampling errors occur when the survey sample design itself allows for systematic error. For example, in the early CBECS, buildings under 1,000 square feet were included in the survey sample. It was later discovered that these small buildings could not be accurately represented in a national CBECS survey and were excluded in 1986. This deficient representation could be considered a biased

sampling error. It is believed that there are few large systematic biases in the RECS and CBECS estimates and to a great extent the sampling errors which occur are random.

Appendix C

Data Quality

Because the estimates in this report are based on observations from randomly chosen subsets of the entire population of commercial buildings and residential households and these observations span a 10-year period, several factors arise, which affect the quality of the data. This appendix briefly discusses nonresponse adjustment procedures, computation of relative standard errors (RSE), development of a common unit of analysis (i.e., the building), the energy price index used to maintain constant purchasing power, and the undercoverage issue associated with the early CBECS.

Nonresponse Adjustment

There are two major types of nonresponse: unit nonresponse and item nonresponse. Most unit nonresponse occurs when a respondent refuses to cooperate or is unavailable. Item nonresponse occurs when the respondent does not know or, less frequently, refuses to give the answer to a particular question or when the interviewer does not ask the question or does not record the answer during the interview. The next two sections provide details on the procedures followed to deal with each type of nonresponse.

Adjustments for Item Nonresponse

Nonresponses to several items in otherwise completed questionnaires were treated by a technique known as "hot-deck imputation." In hot-decking, when a certain response is missing for a given case, another case (called a "donor") is randomly selected to furnish its reported value for that missing item. That value is then assigned to the case with the item nonresponse (the nonrespondent, or "receiver"). To serve as a donor, a case must be similar to the nonrespondent in characteristics correlated with the missing item.

In some cases, the energy supplier did not provide the consumption or expenditures data for some or all billing periods or deliveries in the survey year, as requested in the Supplier Survey. Reasons for missing data have included energy supplier refusal; archived, lost, or destroyed billing records; and, waiver refusal on the part of the building or household respondent. In other cases, the energy supplier provided data, but either the building data were combined with those of nonsampled buildings and could not be disaggregated or the consumption or expenditures or both were not completed enough to be treated as missing.

The general approach taken to impute annual consumption and expenditures was to annualize the complete or partial sets of bills first and then to use these annualized bills in regression equations to develop imputed values for the data that were totally missing. The regression imputation approach was chosen because data from the Building or Household Survey were already available for the buildings (households) lacking energy supplier data. The first step to correcting this problem was to estimate missing consumption data on the basis of regression equations developed using building characteristics in cases where the consumption was already known. After the consumption had been imputed, missing expenditures were estimated based on the reported or imputed consumption. For a more in-depth discussion of the adjustment process for item nonresponse of consumption and expenditures, see the appendices of previous publication of the RECS or CBECS.[19]

[19]See Appendix E, "Related EIA Energy Consumption Publications."

Adjustments for Unit Nonresponse

Weight adjustment is the method used to reduce unit nonresponse bias in the CBECS survey statistics. The CBECS was designed so that survey responses can be used to estimate characteristics of the entire stock of nonresidential buildings in the contiguous United States. The method of estimation is to calculate basic sampling weights that relate the sampled buildings to the entire stock of nonresidential buildings. To reduce bias for unit nonresponse in the survey statistics, the base weights of respondent buildings are adjusted upward, so that the respondent buildings will represent not only unsampled buildings but also nonrespondent buildings. For a more in depth discussion of the adjustment process for unit nonresponse, see the appendices of previous publications of the CBECS.[20]

Similarly, the RECS also uses weight adjustment to reduce unit nonresponse bias. An additional adjustment is performed to improve the representation of the population by the RECS sample as a whole (regardless of response levels). Ratio estimation is used to adjust selected estimates of household counts to official population values. The ratio adjustment is arrived at in several stages and ultimately benchmarks the RECS estimates to the Bureau of the Census population estimates at a regional level. For a more in-depth discussion, see the appendices of previous publications of the RECS.[21] No similar adjustment is used for CBECS because no independent benchmark totals are available for the commercial buildings population.

Relative Standard Errors

For some surveys, a convenient algebraic formula for computing variances can be obtained. However, both the CBECS and the RECS use a multistage area sample design of such complexity that it is virtually impossible to construct an exact algebraic expression for estimating variances. Due to the complexity of the sample designs, the CBECS uses a jackknife replication method for variance estimation and the RECS uses the balanced half-sample replication method (also termed BRR). For more details about the jackknife replication method, see Appendix C, "Nonsampling and Sampling Errors," of the 1992 CBECS reports. For more details about BRR variance estimation method, see Appendix B, "Quality of the Data," of the 1990 RECS reports.

The relative standard error (RSE) is the square root of the mean square error, expressed as a percent of the estimate. The RSE was used for any statistical tests or confidence intervals given in the text. Estimates with RSE greater than 50 percent are withheld from the published tables due to their lack of precision.

Space limitations prevent publishing the complete set of RSE's with this report. Instead, a generalized variance technique is provided, by which the reader can compute an approximate RSE for each of the estimates in the tables. For an estimate in the i^{th} row and j^{th} column of a particular table, the approximate RSE is found by multiplying the row factor in the rightmost column of row i by the column factor given at the top of column j. See Figure C1.

[20]See Appendix E, "Related EIA Energy Consumption Publications."

[21]See Appendix E, "Related EIA Energy Consumption Publications."

Figure C1. Use of RSE Row and Column Factors

Table C1. Commercial Building Characteristics, 1989

Building Characteristics	Total Floorspace (million square feet)	Buildings (thousand)	Floorspace per Building (square feet)	RSE Row Factors
RSE Column Factors:	1.2	1.1	0.8	
All Buildings	63,184	4,528	13,955	3.4
Census Region				
Northeast	13,569	783	17,320	8.3
Midwest	15,955	1,046	15,255	7.8
South	22,039	1,847	11,932	5.9
West	11,620	851	13,651	7.3

R(South) = 5.9
C(Buildings) = 1.1
Approximate RSE(South, Buildings)
= (5.9) * (1.1) = 6.49 percent.
Approximate Standard Error(South, Buildings)
= (0.0649) * (1,847) = 119.9 thousand.

Source: Energy Information Administration, Office of Energy Markets and End Use, Energy End Use and Integrated Statistics Division, the 1989 Commercial Buildings Energy Consumption Survey.

For more details about the derivation of the row and column RSE factors, see Appendix C, "Nonsampling and Sampling Errors," of the 1992 CBECS reports.

Residential Buildings as Units of Analysis

The RECS is a survey of United States households. All of the estimates presented in the RECS reports are based on the housing unit as the primary unit of measurement. Sometimes, as in this report, the population of interest is not the housing unit but the building itself. Hence, the problem arises of recasting the estimates to reflect the new unit of analysis (i.e., the residential building).

Definitions

To demonstrate the underlying differences between a housing unit and a residential building, consider the following definitions.

Housing Unit: A house, an apartment, a group of rooms, or a single room if it is either occupied or intended for occupancy as separate living quarters by a family, an individual, or a group of one to nine unrelated persons.

> Residential Building: A structure used primarily as a dwelling for one or more households that is totally enclosed by walls that extend from the foundation to the roof.

By this definition, a single-family attached housing unit (such as a single side of a duplex) would be considered a single building. In other words, the number of single-family attached housing units is equivalent to the number of single-family attached buildings. This one-to-one correspondence between housing units and residential buildings also exists between single-family detached housing units and mobile homes and the buildings which they represent; however, it does not exist for multi-unit apartment buildings. These are the RECS units whose data must be recast into the building frame of reference. Procedures for adjusting these data are given in the next subsection, "Derivation of Weights."

If only one housing unit is represented in a residential building, then the housing unit immediately corresponds to the CBECS definition of a building:

> Building: A structure totally enclosed by walls that extend from the foundation to the roof and intended for human access.

After the multi-unit data are adjusted to the building level, residential and commercial sector data can be compared or combined because both are based on the unit definition of building.

Two significant problems arise in deriving residential building estimates from RECS housing unit estimates: the number of buildings in the total population are likely to be undercounted and the size of multi-unit buildings is likely to be underestimated.

- Buildings are undercounted because RECS interviews are not conducted in vacant housing units. It is likely that the amount of underestimation is similar to the rate of housing unit vacancy, which the 1989 American Housing Survey estimated at about 9 percent.

- The size of the multi-unit buildings is understated because the floorspace of common areas, such as hallways, stairwells, elevators, or lobbies, is not accounted for.

We recognize these problems, but we do not attempt to account for them when deriving building estimates from housing unit estimates.

Derivation of Weights

In order to reduce bias in the survey statistics, the sample units are weighted to reflect the selection probability, P_i, and to adjust for unit nonresponse. The base weight for the i^{th} unit is:

$$w_i = \frac{1}{P_i}.$$

The adjustment for unit nonresponse is designed to spread the effects of nonresponse over the entire responding sample. It is equal to:

$$a_i = \frac{\sum_{i \subseteq S} w_i}{\sum_{i \subseteq R} w_i};$$

where S is the entire sample and R is the respondent subset of S. The adjusted housing unit weight is the product of the weight and the adjustment:

$$hu_{adj} = w_i \, a_i.$$

This process of weight adjustment has been used for all cycles of the RECS.

The calculations for deriving building estimates were performed in the *Household Energy Consumption and Expenditures, 1990*. In multi-unit buildings, the specific number of housing units in the building containing the i^{th} sampled housing unit, u_i, is needed to convert housing unit data to building data. Viewing $1/u_i$ as a proportion of the residential building,

$$b_i = \frac{1}{u_i},$$

which makes the adjusted building weight equivalent to:

$$bld_{adj} = w_i \, a_i \, b_i.$$

In this way, estimates based on housing units can be transformed into building estimates.

Example. Suppose the specific estimate of interest is the count of the number of housing units, HU, or buildings, BLD. Then with *n* equal to the number of sample units, the number of housing units in the population is estimated by

$$HU = \sum_{i=1}^{n} (a_i \, w_i) ,$$

and the estimated number of buildings is

$$BLD = \sum_{i=1}^{n} (a_i \, w_i \, b_i).$$

Let $sfhu_i$ be the floorspace in square feet for the i^{th} housing unit in a particular building. Because total building floorspace data are not collected, the true proportion of the building floorspace that the i^{th} housing unit occupies is unknown. Assuming that the individual unit chosen in the sample is representative of the other units in the same building, the floorspace of the building containing the i^{th} unit, $sfbld_i$, is estimated to be the product of the sampled unit's floorspace, $sfhu_i$, and the number of units in the i^{th} building, u_i. In this way, each sampled unit is a proportionally smaller representative of a larger separate single building,

$$sfhu_i = sfbld_i * b_i$$

so that,
Unless the number of housing units in a building is one, it is expected that changes in count among the categories will occur because, generally, in multi-unit buildings,

$$sfbld_i = (sfhu_i * u_i) .$$

$$Category(sfbld_i) \neq Category(sfhu_i).$$

However, the **sum** of the weighted estimates of the amount of floorspace in all sample housing units and the **sum** of all subsequent building floorspace estimates are equivalent. The estimates are equivalent because the proportion of floorspace a housing unit occupies in a building is assumed to be the reciprocal of the number of units in the building. If the true proportion were known, then the two estimates would not necessarily be equivalent.

The total floorspace in all units is

$$SFHU = \sum_{i=1}^{n} (a_i w_i * sfhu_i) ,$$

and the total floorspace in all residential buildings is

$$SFBLD = \sum_{i=1}^{n} (a_i w_i b_i * sfhu_i u_i) .$$

Rearranging and using the definition of b_i, this becomes

$$SFBLD = \sum_{i=1}^{n} (a_i w_i * sfhu_i * \frac{1}{u_i} u_i).$$

That is, the total square feet of occupied floorspace in residential buildings does indeed equal the total square feet of floorspace in housing units. Estimates of square feet per unit of analysis, however, will be different between housing units and buildings. In general, estimates of **totals** as well as any **ratio of totals to totals** (e.g., total floorspace, total consumption, consumption per square foot, etc.) will not differ between the units of analysis. However, estimates of **totals per unit of analysis** (e.g., square feet per building/household, consumption per building/household, etc.) will necessarily be different because the total number of each unit of analysis is different.

The Choice of an Energy Price Index

In this report, data are presented for consumption and expenditures for both the residential and commercial sectors with a common unit of analysis, the building. For consistency, the energy price indices that were developed as part of the *State Energy Price and Expenditure Report 1992* (SEPER 1992) can be used as the deflators in the energy expenditure tables of the report. The following section describes these energy price indices.

State Energy Price and Expenditure Report 1991 (SEPER 1992): Real Fixed-Weight Energy Price Index

In order to compare price data between years, the SEPER uses fixed-weight price indices. The nominal fixed-weight energy price index is a measure of the average price of net energy consumption in 1987, the weight-base year. The composition of net energy consumption is held constant at 1987 weights for each year. The 1987 weights consist of detailed energy source and end-use sector categories for each State and the relative distribution of net energy consumption among the various States. The real fixed-weight energy price index is then obtained by dividing the

nominal fixed-weight energy price index by the gross domestic product purchases (GDP) benchmark-years-weighted price index (See Appendix D in SEPER 1992).

Using the *State Energy Price and Expenditure Data System 1991*, fixed-weight energy price indices were developed by sector for total energy and for each of the major energy sources. The following are the nominal and real fixed-weight energy price indices for the commercial and residential sectors (Tables C1, C2, and C3). The deflator that was used in this report to adjust current dollars to 1987 dollars was the gross domestic purchases (GDP) deflator. The nominal fixed-weight energy price index can be used to analyze changes in expenditures with the energy product mix benchmarked to 1987.

Table C1. Energy Price Indices, 1979 to 1991 (1987 = 100)

Year	Energy Price Indices				Gross Domestic Purchases (Benchmark Years)
	Residential		Commercial		
	Nominal	Real	Nominal	Real	
1979	62.8	94.2	67.7	92.6	66.6
1980	75.2	102.2	81.3	110.5	73.6
1981	87.5	109.1	94.3	117.6	80.2
1982	97.5	115.0	103.3	121.8	84.8
1983	103.4	117.8	106.9	121.7	87.8
1984	103.4	113.9	108.0	119.0	90.8
1985	105.1	111.9	108.7	115.8	93.9
1986	101.6	105.2	103.6	107.3	96.6
1987	100.0	100.0	100.0	100.0	100.0
1988	100.0	96.2	98.8	95.1	103.9
1989	103.7	95.5	101.6	93.5	108.6
1990	107.8	94.9	104.9	92.3	113.6
1991	109.6	93.0	106.3	90.2	117.9

Note: Calculations are based on unrounded numbers.
Sources: **Nominal Fixed-Weight Energy Price Index**–Based on net energy consumption (1987 fixed-quantity weights) and end-use price data from EIA, *State Energy Price and Expenditure Data System 1991*. **Real Fixed-Weight Price Index**–Nominal energy fixed-weight price index/Gross Domestic Purchases benchmark-years-weighted price index. **Gross Domestic Purchases, Price Index, 1987 = 100, Benchmark-Years-, 1980-1991**–U.S. Department of Commerce, Bureau of Economic Analysis, *Survey of Current Business*, April 1993, Volume 73, No. 4., p. 35, and *National Income and Product Accounts of the United States*, Volume 2, 1959-88, pp. 266-267.

Table C2. Residential Energy Price Indices for Specific Energy Sources, 1979 to 1990 (1987 = 100)

Year	Residential Energy Price Indices					
	Nominal			Real		
	Electricity	Natural Gas	Fuel Oil	Electricity	Natural Gas	Fuel Oil
1979	62.5	55.5	83.5	94.0	83.8	125.4
1980	72.4	67.8	116.1	98.2	92.0	157.5
1981	84.0	78.4	142.9	104.8	97.7	178.2
1982	93.1	94.6	138.8	109.8	111.5	163.7
1983	96.9	110.2	134.1	110.4	125.5	152.7
1984	96.5	111.1	136.4	106.3	122.4	150.2
1985	99.8	111.1	131.3	106.2	118.3	139.8
1986	99.9	105.4	105.3	103.4	109.1	109.0
1987	100.0	100.0	100.0	100.0	100.0	100.0
1988	100.4	98.9	101.0	96.6	95.2	97.2
1989	102.7	101.8	111.7	94.6	93.7	102.8
1990	105.3	104.8	132.5	92.7	92.2	116.6

Note: Calculations are based on unrounded numbers.
Sources: **Nominal Fixed-Weight Energy Price Index**--Based on net energy consumption (1987 fixed-quantity weights) and end-use price data from EIA, *State Energy Price and Expenditure Data System 1991*. **Real Fixed-Weight Price Index**--Nominal energy fixed-weight price index/Gross Domestic Purchases benchmark-years-weighted price index. **Gross Domestic Purchases, Price Index, 1987 = 100, Benchmark-Years-Weights, 1980-1990**-U.S. Department of Commerce, Bureau of Economic Analysis, *Survey of Current Business*, April 1993, Volume 73, No. 4., p. 35, and *National Income and Product Accounts of the United States*, Volume 2, 1959-88, pp. 266-267.

Table C3. Commercial Energy Price Indices for Specific Energy Sources, 1980 to 1991 (1987 = 100)

Year	Commercial Energy Price Indices					
	Nominal			Real		
	Electricity	Natural Gas	Fuel Oil	Electricity	Natural Gas	Fuel Oil
1979	67.2	59.2	100.6	100.9	88.9	151.1
1980	78.6	72.7	142.6	106.7	98.6	193.5
1981	90.7	85.0	175.7	113.1	105.9	219.9
1982	98.8	102.1	169.2	116.5	120.4	199.5
1983	101.1	117.8	154.0	115.1	134.2	175.4
1984	102.5	117.7	152.8	112.9	129.6	168.3
1985	104.5	115.8	142.6	111.3	123.3	151.8
1986	103.4	107.0	101.3	107.0	110.8	104.9
1987	100.0	100.0	100.0	100.0	100.0	100.0
1988	99.5	97.6	95.5	95.8	93.9	91.9
1989	101.6	99.3	111.4	93.5	91.5	102.6
1990	103.9	101.0	132.9	91.4	86.9	116.3
1991	106.7	101.0	121.0	90.5	85.6	102.6

Note: Calculations are based on unrounded numbers.
Sources: **Nominal Fixed-Weight Energy Price Index**--Based on net energy consumption (1987 fixed-quantity weights) and end-use price data from EIA, *State Energy Price and Expenditure Data System 1991*. **Real Fixed-Weight Price Index**--Nominal energy fixed-weight price index/Gross Domestic Purchases benchmark-years-weighted price index. **Gross Domestic Purchases, Price Index, 1987 = 100, Benchmark-Years-, 1980-1991**--U.S. Department of Commerce, Bureau of Economic Analysis, *Survey of Current Business*, April 1993, Volume 73, No. 4. p. 35, and *National I Income and Product Accounts of the United States*, Volume 2, 1959-88, pp. 266-267.

The CBECS Undercoverage Issue

The 1979 CBECS sample design was based on an adaptation of a nonbuilding national survey sample design. By means of using this approach, data could be gathered, assimilated, and analyzed much faster. However, EIA did recognize that readapting this design was an interim solution. The 1979 CBECS sampling frame is suspected of undercovering the building population. Undercoverage could have been the result of exclusion of specific types of buildings (e.g., farm buildings, outbuildings, buildings on military bases), mistakes by listers, or the handling of buildings under construction at the time of listing. Regardless of the source of coverage problems, evidence suggests that an undercounting did occur and introduced nonsampling error into the survey estimates.

The 1983 CBECS sample had two components: (1) a follow-up of all the buildings sampled in 1979 and (2) an update sample from the files of F.W. Dodge[22] to represent all buildings constructed since 1979. Any deficiencies present in the original 1979 sample were also present in the 1983 CBECS estimates for buildings constructed through 1979. Furthermore, the update frame appeared biased towards large buildings, with severe undercoverage of smaller buildings and possible overcoverage of larger buildings.

For the 1986 sample, CBECS constructed a frame designed specifically for a national survey of commercial buildings. An independently drawn sample from the 1986 CBECS frame was used to represent buildings constructed through 1986 in the 1989 CBECS. The 1989 CBECS had a two-part update for new construction. The F.W. Dodge lists were used to update for large buildings, and roughly half of the area sample segments were relisted to update for smaller buildings.

The undercoverage problem associated with the early CBECS surveys can be readily seen in Table C4, which contains estimates of the number of commercial buildings by year of construction for the successive survey years.

Table C4. Number of Commercial Buildings by Year of Construction and Survey Year

Year of Construction	Number of Buildings (thousand)			
	1979 CBECS	1983 CBECS	1986 CBECS	CBECS 1989
Total	3,073	3,185	4,154	4,528
Year of Construction				
1979 or Before	3,073	3,055	3,495	3,667
1980 to 1983	N/A	131	350	317
1984 to 1986	N/A	N/A	309	329
1987 to 1989	N/A	N/A	N/A	215

N/A Not applicable.
Sources: Commercial Buildings Energy Consumption Surveys (CBECS).

The 1979 and 1983 CBECS estimates of the number of buildings constructed before 1980 are very close. This is expected since both estimates are based on the same sample of buildings. Estimates from the 1986 and 1989 CBECS differ more because each was based on independent samples drawn from the same sampling frame. The most notable difference among the estimates is the large increase in the number of buildings built between the 1979/1983 CBECS and the 1986/1989 CBECS. It is believed that this increase reflects the improved sampling frame introduced in 1986. Because the later CBECS estimates more accurately reflect the commercial building stock, this report uses the 1989 CBECS estimates of the building stock constructed in 1979 or before as the lower bound for the true value.

[22]F.W. Dodge, National Information Services Division, McGraw-Hill Information Systems Company, New York, NY. Figures reported currently in *Dodge Construction Potentials.*

It is a lower bound because some buildings, which existed in 1979 were demolished, or because of some type of physical conversion, no longer fit into the definition of a commercial building during the 1980's.

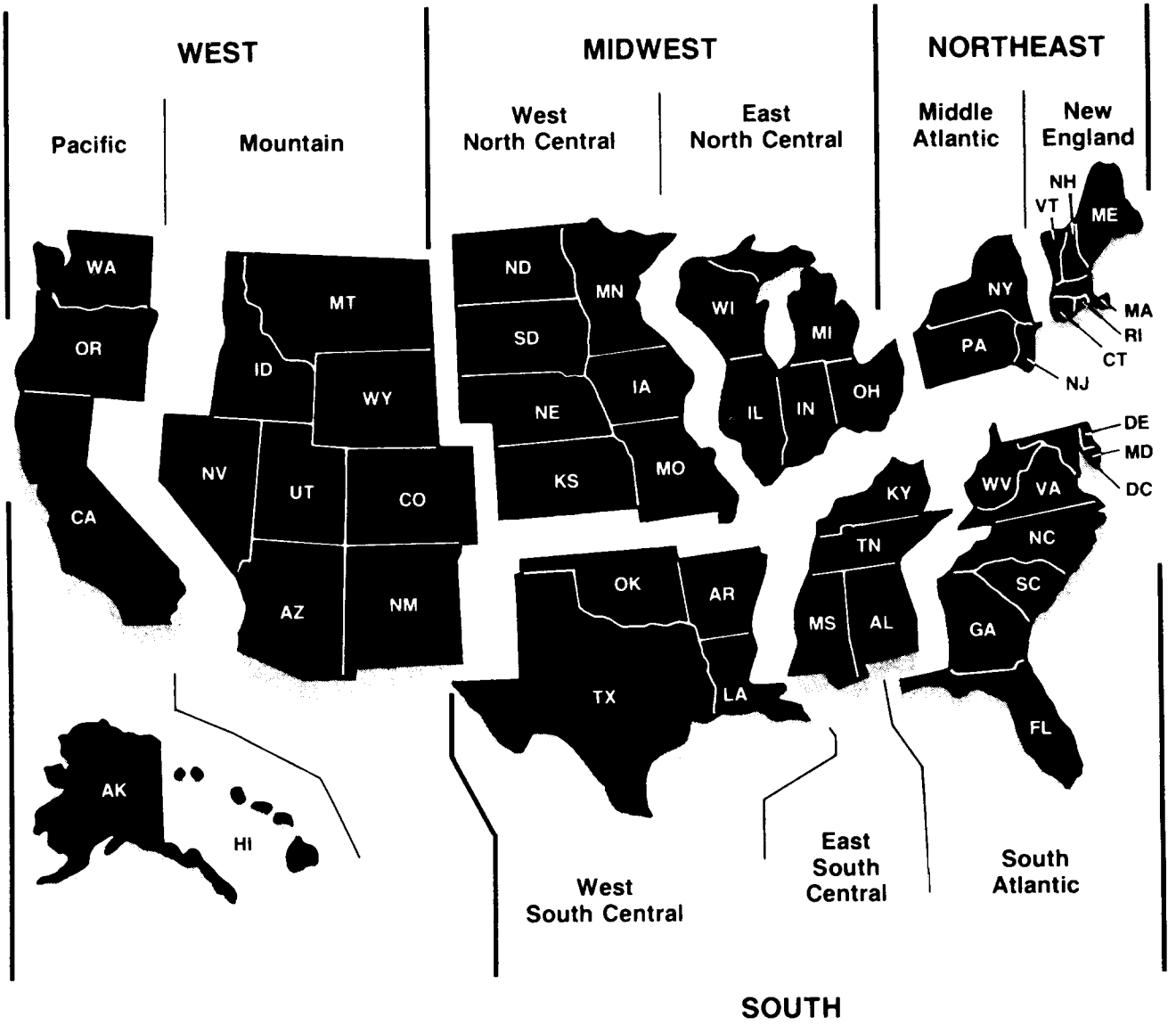
The adjustment was carried out as follows. For building counts and floorspace estimates, the 1989 estimates of pre-1980 construction were substituted for the 1979 estimates, both across the population and for individual subgroups (e.g., regions, size categories, and building types). Consumption estimates for the various fuels in 1979 were created by multiplying the 1989 values of floorspace by the consumption per square foot intensities based on 1979 data. Expenditures for 1979 were computed by multiplying these consumption values by 1979 energy prices adjusted to 1987 dollars.

Primary Electricity Consumption

Electricity consumption can be expressed in terms of either physical units (e.g., kilowatthours), or thermal units (most commonly British thermal units (Btu)). Conversion of electricity use from kilowatthours to Btu can be given in terms of either site electricity or primary electricity. Site electricity is the amount of electricity delivered to the building, while primary electricity is site electricity plus the amount of energy lost during the generation, transmission, and distribution of the electricity. Conversion of site electricity from kilowatthours to Btu is at the universal value of 3,412 Btu per kilowatthour. Because of energy losses, primary electricity is about three times that of site electricity. The exact conversion value varies by year (e.g., 10,388 Btu per kilowatthour in 1980 and 10,335 Btu per kilowatthour in 1990). Conversion values for all survey years are given in the Glossary under **Btu Conversion Factors**.

Appendix D

U.S. Census Regions and Divisions



Appendix E

Related EIA Energy Consumption Publications

For information about how to obtain these publications, see the inside cover of this report. Please note that the prices quoted here are subject to change.

In addition to the reports listed below, public use data tapes and data diskettes for the residential, residential transportation, and commercial sectors are available from the National Technical Information Service (NTIS). To obtain information on how to order the tapes/diskettes, you may call NTIS at 703-487-4807, FAX number 703-321-8547. Data diskettes can also be obtained from the Office of Scientific and Technical Information (OSTI). For OSTI ordering information, call 615-576-8401.

Commercial Sector

Note: The name of the Nonresidential Buildings Energy Consumption Survey was changed to the Commercial Buildings Energy Consumption Survey, beginning with the 1989 survey. The survey name was also dropped from the report title at that time and subsequently.

Characteristics of Buildings

Commercial Buildings Characteristics 1992; April 1994, DOE/EIA-0246(92), GPO Stock No. 061-003-00850-0, $28.00.

"Commercial Buildings Characteristics 1992," *Monthly Energy Review*, January 1994, DOE/EIA-0035(94/01).

Commercial Buildings Characteristics 1989; June 1991, DOE/EIA-0246(89), GPO Stock No. 061-003-00699-0, $18.00.

Nonresidential Buildings Energy Consumption Survey: Characteristics of Commercial Buildings, 1986; September 1988, DOE/EIA-0246(86), GPO Stock No. 061-003-00580-2, $16.00.

Nonresidential Buildings Energy Consumption Survey: Characteristics of Commercial Buildings, 1983; A Supplemental Reference, DOE/EIA-M008, $22.95. Available from the NTIS, Order No. DE-85015581.

Nonresidential Buildings Energy Consumption Survey: Characteristics of Commercial Buildings, 1983; July 1985, DOE/EIA-0246(83), GPO Stock No. 061-003-00439-3, $7.50.

Nonresidential Buildings Energy Consumption Survey: Fuel Characteristics and Conservation Practices; June 1981, DOE/EIA-0278, GPO Stock No. 061-00300200-5, $9.00.

Nonresidential Buildings Energy Consumption Survey: Building Characteristics; March 1981, DOE/EIA-0246, GPO Stock No. 061-003-00171-8, $6.50.

Consumption and Expenditures

Commercial Buildings Consumption and Expenditures 1989; April 1992, DOE/EIA-0318(89), GPO Stock No. 061-003-00753-8, $25.00.

Nonresidential Buildings Energy Consumption Survey: Commercial Buildings Consumption and Expenditures 1986; May 1989, DOE/EIA-0318(86), GPO Stock No. 061-003-00613-2, $19.00.

Nonresidential Buildings Energy Consumption Survey: Commercial Buildings, Consumption and Expenditures 1983; September 1986, DOE/EIA-0318(83), GPO Stock No. 061-003-00496-2, $13.00.

Nonresidential Buildings Energy Consumption Survey: 1979 Consumption and Expenditures, Part 1: Natural Gas and Electricity; March 1983, DOE/EIA-0318/1, GPO Stock No. 061-003-00298-6, $9.50.

Nonresidential Buildings Energy Consumption Survey: 1979 Consumption and Expenditures, Part 2: Steam, Coal, Fuel Oil, LPG, and Total Fuels; December 1983, DOE/EIA-0318(79)/2, GPO Stock No. 061-003-00366-4, $6.00.

Other Publications on the Commercial Sector

Energy Consumption Series-- *Energy End-Use Intensities in Commercial Buildings*, September 1994, DOE/EIA-0555(94)/2, GPO Stock No. 061-003-0087-9, 9.00.

"Assessment of Energy Use in Multibuilding Facilities," *Monthly Energy Review*, December 1993, DOE/EIA-0035(93/12).

Energy Consumption Series--*Assessment of Energy Use in Multibuilding Facilities*, August 1993, DOE/EIA-0555(93)/1, GPO Stock No. 061-003-00817-8, $7.50.

Energy Consumption Series--*User-Needs Study for the 1992 Commercial Buildings Energy Consumption Survey*, September 1992, DOE/EIA-0555(92)/4, GPO Stock No. 061-003-00770-8, $8.50.

Energy Consumption Series--*Lighting in Commercial Buildings*; March 1992, DOE/EIA-0555(92)/1, GPO Stock No. 061-003-00749-0, $6.50.

Residential Sector

Housing Characteristics

Note: The survey name was dropped from the beginning of the report title starting with the 1987 data reports.

Housing Characteristics 1990; May 1992, DOE/EIA-0314(90), GPO Stock No. 061-003-00754-6, $23.00.

Housing Characteristics 1987; May 1989, DOE/EIA-0314(87), GPO Stock No. 061-003-00619-1, $13.00.

Residential Energy Consumption Survey: Housing Characteristics 1984; October 1986, DOE/EIA-0314(84), GPO Stock No. 061-003-00499-7, $12.00.

Residential Energy Consumption Survey: Housing Characteristics, 1982; August 1984, DOE/EIA-0314(82), GPO Stock No. 061-003-00393-1, $7.00.

Residential Energy Consumption Survey Housing Characteristics, 1981; August 1983, DOE/EIA-0314(81), GPO Stock No. 061-003-00330-3, $6.50.

Residential Energy Consumption Survey: Housing Characteristics, 1980; June 1982, DOE/EIA-0314, GPO Stock No. 061-003-00256-1, $11.00.

Residential Energy Consumption Survey: Characteristics of the Housing Stock and Households, 1978; February 1980, DOE/EIA-0207/2, GPO Stock No. 061-003-00093-2, $4.25.

Residential Energy Consumption Survey: Conservation; February 1980, DOE/EIA-0207/3, GPO Stock No. 061--003-00087-8, $6.00.

Preliminary Conservation Tables from the National Interim Energy Consumption Survey; August 1979, DOE/EIA-0193/P (no GPO Stock No.).

Characteristics of the Housing Stock and Households: Preliminary Findings from the National Interim Energy Consumption Survey; October 1979, DOE/EIA-0199/P (no GPO Stock No. available).

Consumption and Expenditures

Note: The survey name was dropped from the beginning of the report title starting with the 1987 data reports. The titles were changed to *Household Energy Consumption and Expenditures 1987, Part 1: National* and *Part 2: Regional.*

"Household Energy Consumption and Expenditures 1990," *Monthly Energy Review*, August 1993, DOE/EIA-0035(93/08).

Household Energy Consumption and Expenditures 1990; February 1993, DOE/EIA-0321/1(90), GPO Stock No. 061-003-00795-3, $22.00.

Household Energy Consumption and Expenditures 1990\S; DOE/EIA-0321/2(90), GPO Stock No. 061-003-00796-1, $21.00.

Household Energy Consumption and Expenditures 1987, Part 1: National Data; October 1989, DOE/EIA-0321/1(87), GPO Stock No. 061-003-00635-3, $15.00. Note: Energy end-use data are included in this report.

Household Energy Consumption and Expenditures 1987, Part 2: Regional Data; DOE/EIA-0321/2(87) (no GPO Stock No. available), $16.00.

Residential Energy Consumption Survey: Consumption and Expenditures, April 1984 Through March 1985, Part 1: National Data; March 1987, DOE/EIA-0321/1(84), GPO Stock No. 061-003-00519-5, $9.50.

Residential Energy Consumption Survey: Consumption and Expenditures, April 1984 Through March 1985, Part 2: Regional Data; May 1987, DOE/EIA-0321/2(84), GPO Stock No. 061-003-00528-4, $17.00. Note: Energy end-use data are included in this report.

Residential Energy Consumption Survey: Consumption and Expenditures, April 1982 Through March 1983, Part 1: National Data; November 1984, DOE/EIA-0321/1(82), GPO Stock No. 061-003-00411-3, $7.00.

Residential Energy Consumption Survey: Consumption and Expenditures, April 1982 Through March 1983, Part 2: Regional Data; December 1984, DOE/EIA-0321/2(82), GPO Stock No. 061-003-00414-8, $9.50.

Residential Energy Consumption Survey: Consumption and Expenditures, April 1981 Through March 1982, Part 1: National Data; September 1983, DOE/EIA-0321/1(81), GPO Stock No. 061-003-00340-1, $6.00.

Residential Energy Consumption Survey: Consumption and Expenditures, April 1981 Through March 1982, Part 2: Regional Data; October 1983, DOE/EIA-0321/2(81), GPO Stock No. 061-003-00357-5, $8.00.

Residential Energy Consumption Survey: Consumption and Expenditures, April 1980 Through March 1981, Part 1: National Data; September 1982, DOE/EIA-0321/1(80), GPO Stock No. 061-003-00278-1, $7.50.

Residential Energy Consumption Survey: Consumption and Expenditures, April 1980 Through March 1981, Part 2: Regional Data; June 1983, DOE/EIA-0321/2(80), GPO Stock No. 061-003-00319-2, $7.00.

Residential Energy Consumption Survey: 1979-1980 Consumption and Expenditures, Part 1: National Data (Including Conservation); April 1981, DOE/EIA-0262/1, GPO Stock No. 061-003-00191-2, $6.50.

Residential Energy Consumption Survey: 1979-1980 Consumption and Expenditures, Part II: Regional Data; May 1981, DOE/EIA-0262/2, GPO Stock No. 061-003-00189-1, $8.50.

Residential Energy Consumption Survey: Consumption and Expenditures, April 1978 Through March 1979; July 1980, DOE/EIA-0207/5, GPO Stock No. 061-003-00131-9, $7.50.

Single-Family Households: Fuel Oil Inventories and Expenditures: National Interim Energy Consumption Survey; December 1979, DOE/EIA-0207/1, GPO Stock No. 061-003-00075-4, $3.50.

Other Publications on the Residential Sector

Energy Consumption Series--*Sample Design for the Residential Energy Consumption Survey*, August 1994, DOE/EIA-0555(94)/1, GPO Stock No. 061-003-00865-8, $6.50.

Energy Consumption Series--*User-Needs Study of the 1993 Residential Energy Consumption Survey*, September 1993, DOE/EIA-0555(93)/2, GPO Stock No. 061-003-00819-4, $13.00.

"End-Use Consumption of Residential Energy" *Monthly Energy Review* (Article), pp. vii-xiv, July 1987, DOE/EIA-0035(87/07).

Residential Energy Consumption Survey: Trends in Consumption and Expenditures 1978-1984 June 1987, DOE/EIA-0482, GPO Stock No. 061-003-00535-7, $12.00.

Residential Conservation Measures; July 1986, SR/EEUD/86/01 (no GPO Stock No.).

An Economic Evaluation of Energy Conservation and Renewable Energy Tax Credits; October 1985, Service Report (no GPO Stock No.).

Residential Energy Consumption and Expenditures by End Use for 1978, 1980, and 1981; December 1984, DOE/EIA-0458, GPO Stock No. 061-003-00415-6, $4.50.

Weatherization Program Evaluation, SR-EEUD- 84-1; August 1984 (available from the Office of the Assistant Secretary for Conservation and Renewable Energy, Department of Energy).

Residential Energy Consumption Survey: Regression Analysis of Energy Consumption by End Use; October 1983, DOE/EIA-0431, GPO Stock No. 061-00300-347-8, $5.00.

National Interim Energy Consumption Survey: Exploring the Variability In Energy Consumption; July 1981, DOE/EIA-0272, GPO Stock No. 061-003-00205-6, $5.00.

National Interim Energy Consumption Survey: Exploring the Variability in Energy Consumption--A Supplement; October 1981, DOE/EIA-0272/S, GPO Stock No. 061-003-00217-0, $4.50.

Energy Use by U.S. Households; November 1980, DOE/EIA-0248 (brochure, no GPO Stock No.).

Residential Transportation Sector

Note: The survey name was dropped from the beginning of the report title starting with the 1988 data report, and the report title was changed to *Household Vehicles Energy Consumption 1988.*

Household Vehicles Energy Consumption 1991; December 1993, DOE/EIA-0464(91), GPO Stock No. 061-003-00652-3, $14.00.

"Energy Preview: Residential Transportation Energy Consumption Survey Preliminary Estimates, 1991," *Monthly Energy Review*, January 1993, DOE/EIA-0035(93/01).

Household Vehicles Energy Consumption 1988; February 1990, DOE/EIA-0464(88), GPO Stock No. 061-003-00652-3, $11.00.

Residential Transportation Energy Consumption Survey: Consumption Patterns of Household Vehicles 1985; April 1987, DOE/EIA-0464(85), GPO Stock No. 061-003-00521-7, $8.50.

Residential Transportation Energy Consumption Survey: Consumption Patterns of Household Vehicles, 1983; January 1985, DOE/EIA-0464(83), GPO Stock No. 061-003-00420-2, $4.50.

Residential Energy Consumption Survey: Consumption Patterns of Household Vehicles, Supplement: January 1981 to September 1981; February 1983, DOE/EIA-0328, GPO Stock No. 061-003-00297-8, $4.75.

Residential Energy Consumption Survey: Consumption Patterns of Household Vehicles, June 1979 to December 1980; April 1982, DOE/EIA-0319 (no GPO Stock No.).

Industrial Sector

Manufacturing Consumption of Energy 1991, December 1994, DOE/EIA-0512(91), GPO Stock No. 061-003-008709, $34.00.

"Energy Preview: Manufacturing Energy Consumption Survey Preliminary Estimates, 1991," *Monthly Energy Review*, September 1993, DOE/EIA-0035(93/01).

"Energy Efficiency in the Manufacturing Sector," *Monthly Energy Review* (Article), p.1, December 1992.

Manufacturing Energy Consumption Survey: Changes in Energy Intensity in the Manufacturing Sector 1980-1988, December 1991, DOE/EIA-0552(80-88). GPO Stock No. 061-003-00734-1, $4.75.

Manufacturing Energy Consumption Survey: Manufacturing Fuel-Switching Capability 1988; September 1991, DOE/EIA-0515(88), GPO Stock No. 061-003-00720-1, $9.00.

Manufacturing Energy Consumption Survey: Consumption of Energy, 1988; May 1991, DOE/EIA- 0512(88), GPO Stock No. 061-003-00703-8, $11.00.

Manufacturing Energy Consumption Survey: Energy Efficiency in Manufacturing, 1985; January 1990, DOE/EIA-0516(85), GPO Stock No. 061-003-00650-7, $4.25.

Manufacturing Energy Consumption Survey: Fuel-Switching Capability, 1985; December 1988, DOE/EIA-0515(85), GPO Stock No. 061-003-00601-9, $3.50.

Manufacturing Energy Consumption Survey: Methodological Report, 1985; November 1988, DOE/EIA0514(85), GPO Stock No. 061-003-00595-1, $6.00.

Manufacturing Energy Consumption Survey: Consumption of Energy, 1985; November 1988, DOE/EIA-0512(85), GPO Stock No. 061-003-00594-2, $6.00.

"Manufacturing Sector Energy Consumption 1985 Provisional Estimates," *Monthly Energy Review* (Article), pp. vii-x, January 1987, DOE/EIA-0035(87/01).

Report on the 1980 Manufacturing Industries' Energy Consumption Study and Survey of Large Combustors; February 1983, DOE/EIA-0358, GPO Stock No. 061-003-00293-5, $5.00.

Industrial Energy Consumption, Survey of Large Combustors: Report on Alternate Fuel-Burning Capabilities of Large Boilers in 1979; February 1982, DOE/EIA-0304, GPO Stock No. 061-003-0233-1, $2.50.

Methodological Report of the 1980 Manufacturing Industries Survey of Large Combustors (EIA-463); March 1982, DOE/EIA-0306 (no GPO Stock No.).

Other Publications on the Industry Sector

Energy Consumption Series--*Derived Annual Estimates of Manufacturing Energy Consumption 1974-1988*, August 1992, DOE/EIA-0555(92)/3, GPO Stock No. 061-003-00766-0, $7.00.

Energy Consumption Series--*Development of the 1991 Manufacturing Energy Consumption Survey*, May 1992, DOE/EIA-0555(92)/2, GPO Stock No. 061-003-00757-1, $5.50.

Cross-Sector

Energy Consumption by End-Use Sector: A Comparison of Measures by Consumption and Supply Surveys; April 6, 1990, DOE/EIA-0533 (no GPO Stock No. available), $2.50.

Natural Gas: Use and Expenditures; April 1983, DOE/EIA-0382, GPO Stock No. 061-003-00307-9, $5.50.

Public Use Tapes

Note: All tapes are available through the NTIS.

Residential and Residential Transportation Sectors

Residential Energy Consumption Survey: 1987 and Residential Transportation Energy Consumption Survey, 1988, Order No. PB90-501461, $220.

Residential Energy Consumption Survey: 1984 and Residential Transportation Energy Consumption Survey, 1985; Order No. PB87-186540, $220.

Residential Energy Consumption Survey: 1982 and Residential Transportation Energy Consumption Survey, 1983; Order No. PB85-221760, $220.

Residential Energy Consumption Survey: Consumption and Expenditures, 1980-1981; Monthly Billing Data; Order No. PB84-166230, $220.

Residential Energy Consumption Survey: Housing Characteristics, 1981; Consumption and Expenditures, 1981-1982; Monthly Billing Data; Order No. PB84-120476, $220.

Residential Energy Consumption Survey: Housing Characteristics, Annualized Consumption and Expenditures, 1980-1981; Order No. PB83-199554, $220.

Residential Energy Consumption Survey: Household Transportation Panel Monthly Gas Purchases and Vehicle and Household Characteristics, 6/79-9/81; Order No. PB84-162452, $220.

Residential Energy Consumption Survey: Household Screener Survey, 1979-1980; Order No. PB82-114877, $220.

Residential Energy Consumption Survey: Household Monthly Energy Consumption and Expenditures, 1978-1979; Order No. PB82-114901, $220.

National Interim Energy Consumption Survey (Residential), 1978; Order No. PB81-108714, $220.

Commercial Sector

Nonresidential Buildings Energy Consumption Survey: 1986 Data; Order No. PB90-500034, $220.

Nonresidential Buildings Energy Consumption Survey: 1979 and 1983 Data; Order No. PB88-245162, $220.

Public Use Diskettes

Note: Diskettes are available through the Office of Scientific and Technical Information (OSTI).

Residential Energy Consumption Survey 1990 Data, **OSTI** - ASCII (3 diskettes) or dBASE (2 diskettes) format, order by title, $10 per diskette. **NTIS** - ASCII format: Order No. PB-93-506103 and dBASE format: Order No. PB-93-506095.

Residential Energy Consumption Survey 1987 Data, **OSTI** - ASCII or dBASE format, order by title, $45 for each set. **NTIS** - ASCII format: Order No. PB-91-505115, $130, and DBASE format: Order No. PB-91-505107, $130.

Commercial Buildings Energy Consumption Survey 1992 Data, **OSTI** - ASCII or dBASE format, order by title, $10 per diskette, $40 set of four. **NTIS** - ASCII or dBASE format, order by title, call for prices.

Commercial Buildings Characteristics 1992 Data, **OSTI** - ASCII or dBASE format, order by title, $10 per diskette, $40 set of four. **NTIS** - ASCII or dBASE format: Order No. PB-94-504305, call for prices.

Commercial Buildings Energy Consumption Survey 1989 Data, **OSTI** - ASCII format, order by title, $10 per diskette, $40 set of four. **NTIS** - ASCII or dBASE format: Order No. PB92-504232, $140.

Nonresidential Buildings Energy Consumption Survey 1986 Data, **NTIS** - ASCII format: Order No. PB91-506808, $130.

Residential Transportation Energy Consumption Survey 1991 Data, **OSTI** - ASCII or dBASE format, order by title, call for prices. **NTIS** - ASCII format: Order No. PB94-500824. dBASE format: Order No. PB94-500816, call for prices.

Residential Transportation Energy Consumption Survey 1988 Data, **GPO** - ASCII or dBASE format, order by title, $15 for each set. **NTIS** - ASCII format: Order No. PB91-507269, dBASE format: Order No. PB91-507277, $50 each.

Planned Publications

Household Energy Consumption and Expenditures 1993, planned for September 1995.

Changes of Energy Intensity in the Manufacturing Sector 1985-1991, planned for July 1995.

EPACT Section 407 Data System: Results from Atlanta Clean City Fleet Vehicle Survey, planned for October 1995.

EPACT Section 407 Data Program: The Vehicle Stock and New Survey Findings, planned for December 1995.

Service Report: Federal Buildings Supplemental Survey Results, planned for October 1995.

Measuring Energy Efficiency in the U.S. Economy (Energy Consumption Series), planned for late 1995.

Note: The Energy Information Administration also publishes annually the *State Energy Data Report, Consumption Estimates*, DOE/EIA-0214, and the *State Energy Price and Expenditures Report*, DOE/EIA-0376; and the *Monthly Energy Review*, DOE/EIA-0035. These reports contain annual and monthly consumption information derived from EIA supply surveys.

Glossary

Air Conditioning: See **Energy End Use**, *Cooling*.

Authorization Form: A form signed by the respondent authorizing energy supplier companies that serve the building to release information on the amounts and costs of energy consumed in the building during a specified period. (See **Energy Supplier**.)

British Thermal Unit: A unit of energy consumed by or delivered to a building. A Btu is defined as the amount of energy required to increase the temperature of 1 pound of water by 1 degree Fahrenheit, at normal atmospheric pressure. Energy consumption is expressed in Btu in this report to allow for consumption comparisons among fuels that are measured in different units. (See **Metric Conversion Factors.**)

Btu: See **British Thermal Unit**.

Btu Conversion Factors: The Btu conversion factors for this report are as follows:

Energy Source	Btu Equivalent	Unit
Electricity	Varies[a]	kilowatthour
Natural Gas	Varies[b]	cubic foot
Distillate Fuel Oils (Nos. 1,2, and 4)	138,690	gallon
Residual Fuel Oils (Nos. 5 and 6)	149,690	gallon
Kerosene	135,000	gallon
District Heat (Steam and Hot Water)	1,000	pound

[a]The Btu equivalent of primary electricity varies by survey year: in 1979, 10,353; in 1980, 10,388; in 1981, 10,453; in 1982, 10,454; in 1983, 10,520; in 1984, 10,440; in 1986, 10,446; in 1987, 10,419; in 1989, 10,317; and, in 1990, 10,335.

[b]The Btu equivalent of natural gas varies by survey year: in 1979, 1,019; in 1980, 1,021; in 1981, 1,027; in 1982, 1,027; in 1983, 1,031; in 1984, 1,031; in 1986, 1,029; in 1987, 1,031; in 1989, 1,030; and, in 1990, 1,027.

Sources: Energy Information Administration, *Monthly Energy Review* (April 1995), DOE/EIA-0035(95/04) for electricity, natural gas, distillate fuel oils, residual fuel oils, and kerosene; and *Methodological Issues in the Nonresidential Buildings Energy Consumption Survey* (September 1983) for district steam.

Building: For this report, a structure totally enclosed by walls extending from the foundation to the roof. Structures that were included in the survey as specific exceptions were commercial parking garages not totally enclosed by walls and a roof and structures erected on pillars which elevate the first fully enclosed level, but leave the sides at ground level open. (See **Commercial Building, Residential Building**, and **Housing Unit**.)

Building Floorspace: See **Floorspace**.

CDD: See **Cooling Degree-Days (CDD)**.

Census Division: A geographic area consisting of several States defined by the U.S. Department of Commerce, Bureau of the Census. (See the Census Regions and Divisions map in Appendix D.)

Region	Division	States
Northeast	New England	Connecticut, Maine, Massachusetts, New Hampshire, Vermont, and Rhode Island
	Middle Atlantic	New Jersey, New York, and Pennsylvania

Midwest	East North Central	Illinois, Indiana, Michigan, Ohio, and Wisconsin
	West North Central	Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, and South Dakota
South	South Atlantic	Delaware, the District of Columbia, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, and West Virginia
	East South Central	Alabama, Kentucky, Mississippi, and Tennessee
	West South Central	Arkansas, Louisiana, Oklahoma, and Texas
West	Mountain	Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming
	Pacific	Alaska, California, Hawaii, Oregon, and Washington

Census Region: See **Census Division** and the Census Regions and Divisions map in Appendix D of this report.

Coal: See **Energy Source**, *Coal.*

Commercial: Neither residential, manufacturing, nor agricultural. (See **Commercial Building**.)

Commercial Building: A building used primarily for commercial activities. Commercial buildings include, but are not limited to, stores, offices, schools, churches, gymnasiums, libraries, museums, hospitals, clinics, warehouses, and jails. Government buildings were included except for buildings on sites with restricted access, such as some military bases or reservations. Farms and buildings located on farms (such as silos, grain elevators, and barns) were excluded. (See **Building**, **Commercial**, and **Principal Building Activity.**)

Commercial Floorspace: All the area enclosed by the exterior walls of a commercial building, including hallways, lobbies, stairways, and elevator shafts. (See **Residential Floorspace**.)

Consumption: The amount of energy used by, or delivered to, a building during a given period of time. Statistics for this report are presented on an annual basis for the calendar year. Data on energy consumption were not collected by end uses separately. For example, although it might be known that electricity was used in some buildings for heating, the consumption of electricity reported for those buildings would typically include other uses of electricity as well (such as lighting and water heating).

For this report, all consumption statistics, unless otherwise noted, consist of primary electricity, and site energy for all other energy sources. (See **Btu**, **Energy Supplier**, **Primary Electricity**, and **Site Energy**.)

Conversion Factors: See **Btu Conversion Factors** and **Metric Conversion Factors**.

Cooking: See **Energy End Use**, *Cooking.*

Cooling: See **Energy End Use**, *Cooling.*

Cooling Degree-Days (CDD): A measure of how hot a location was over a period of time, relative to a base temperature. In this report, the base temperature is 65 degrees Fahrenheit (approximately 18 degrees Celsius), and the period of time is 1 year. The cooling degree-days for a single day is the difference between that day's average temperature and the base temperature if the daily average is greater than the base and zero if the daily average temperature is less than or equal to the base temperature. The cooling degree-days for a longer period of time is the sum of the daily cooling degree-days for the days in that period. One cooling degree-day Fahrenheit equals five-ninths of a degree-day Celsius. (See **Heating Degree-Days (HDD)**)

Cubic Foot: As a natural gas measure, the volume of gas at standard temperature and pressure (60 degrees Fahrenheit and 14.73 pounds standard per square inch) contained in a cube which has edges equal to 1 foot. The thermal content varies by the composition of the gas. (See **Energy Source,** *Natural Gas* and **Btu.**)

District Chilled Water: See **Energy Source**, *District Chilled Water.*

District Heat: See **Energy Source**, *District Heat.*

District Hot Water: See **Energy Source**, *District Heat.*

District Steam: See **Energy Source**, *District Heat.*

Electricity: See **Energy Source**, *Electricity.*

Energy End Use: A use for which energy is consumed in a building. Each end use for which estimates were provided in this report are given below. The general meaning of each end use, as defined by the CBECS and RECS are also provided.

RECS	Energy End Use	CBECS
Use of mechanical equipment (includes wood stoves and active solar heating devices) to heat all or part of a building to at least 50 degrees Fahrenheit.	**Space Heating**	Use of mechanical equipment (includes wood stoves and active solar heating devices) to heat all or part of a building to at least 50 degrees Fahrenheit.
Energy used to heat water for hot running water and to heat water on a stove and auxiliary water heating equipment for bathing, cleaning, and other noncooking applications.	**Water Heating**	Use of energy to heat water for purposes other than space heating.
See **Air Conditioning** and **Appliances**.	**Cooling**	Conditioning of room air for human comfort by a refrigeration unit or evaporative cooler or by circulating chilled water through a central cooling or district cooling system. Use of fans or blowers by themselves, without chilled air or water, is not included.
Cooling and dehumidification of air in a building by a refrigeration unit driven by electricity or gas. This includes units that are unused and those that are not in working condition and excludes fans, blowers, and evaporative cooling systems that are not connected to a refrigeration unit.	**Air Conditioning**	Included in **Cooling**.
Energy for all uses except those covered by space heating, water heating, and air conditioning. These include: lighting, television, personal computers, washing machines, refrigeration, and most small appliances. Special energy uses for appliances are energy used to heat: food, water for cooking, water for hot drinks, air to dry clothes, water in a water bed, and water for a swimming pool. Also included is energy to operate fans for a central forced-air space-heating system or air-conditioning system and energy for an evaporative cooling system.	**Appliances**	Not applicable.

RECS	Energy End Use	CBECS
Included in **Appliances.**	**Ventilation**	The circulation of air through a building to provide fresh air to the occupants and to deliver heating and cooling to the occupied spaces.
Included in **Appliances.**	**Lighting**	The illumination of the interior of a building by use of artificial sources of light.
Included in **Appliances.**	**Cooking**	Use of energy for commercial or institutional food preparation.
Included in **Appliances.**	**Refrigeration***	Use of energy to maintain perishable goods at a cool temperature for storage or sale.
Not applicable.	**Manufacturing**	Any energy-using operations required for manufacturing/industrial processes.
Not applicable.	**Office Equipment**	A class of energy-using equipment including typewriters, copiers, cash registers, computer terminals, personal computers, printers, mainframe computer systems, and other miscellaneous office equipment.
Included in **Appliance.**	**Other**	Use of energy for all end uses not specifically mentioned.

*In the 1990 RECS, energy used for refrigeration was not included in the appliance end use category; instead, refrigeration was considered a separate end use. For consistency among survey years, the 1990 appliance end use category includes energy used for refrigeration.

Energy Intensity: The ratio of energy consumption to some measure of demand for services provided by energy. In this report, energy intensity is given on an aggregate basis, as the ratio of total consumption of an energy source for a set of buildings to the total floorspace served by that energy source in those buildings. (See **Consumption**.)

Energy Source: A type of energy or fuel consumed in the building. For this report, the energy sources identified are:

RECS	Energy Source	CBECS
Metered electric power supplied by a central utility company to a residence via power lines. Electricity is measured as the amount of power used at any instant (demand expressed in watts or kilowatts) or as power used over a given time (consumption expressed in kilowatthours).	**Electricity**	Electric energy supplied to a building by a central utility via power lines or from a central physical plant in a separate building that is part of the same multibuilding facility. Electric power generated within a building for exclusive use in that building is specifically excluded from the definition of electricity as an energy source.
Hydrocarbon gas (mostly methane) supplied as an energy source to individual buildings by pipelines from a central utility company. Natural gas does not refer to liquified petroleum gas or to privately owned gas wells operated by a building owner.	**Natural Gas**	Hydrocarbon gas (mostly methane) supplied as an energy source to individual buildings by pipelines from a central utility company. Natural gas does not refer to liquified petroleum gas or to privately owned gas wells operated by a building owner.
A liquid petroleum product less volatile than gasoline. It includes distillate fuel oil (No. 1, No. 2, and No. 4).	**Fuel Oil**	A liquid petroleum product less volatile than gasoline. It includes distillate fuel oil (No. 1, No. 2, and No. 4), residual fuel oil (No. 5 and No.6), and kerosene.
A petroleum distillate with properties similar to those of No. 1 fuel oil, used primarily in space heaters, cooking stoves, and water heaters.	**Kerosene**	Included in **Fuel Oil.**
Any fuel gas supplied to a residence in liquid form, such as propane or butane. It is usually delivered by tank truck and stored near the residence in a tank or cylinder until used.	**Liquefied Petroleum Gas (LPG)**	Included in **Propane.**
Included in **Liquefied Petroleum Gas (LPG).**	**Propane**	A gaseous petroleum product that liquefies under pressure; propane is a major component in liquefied petroleum gas (LPG). Any LPG reported was assumed to be propane.

RECS	Energy Source	CBECS
Not applicable.	**District Heat**	Steam or hot water from an outside source used for any end use in a building. The steam or hot water is produced in a central plant and piped into the building. The district heat may be purchased from a utility or provided by a central physical plant in a separate building this is part of the same multibuilding facility. District steam and district hot water are reported together in this report.
Not applicable.	**District Chilled Water**	Chilled water from an outside source used as an energy source for cooling. The water is chilled in a central plant and piped into the building. Chilled water may be purchased from a utility or provided by a central physical plant in a separate building that is part of the same multibuilding facility.
Wood, solar, and coal.	**Other***	Wood

*The other energy source category is included in the *All Energy Source* categories in tables found in Appendix A, "Detailed Tables."

Energy Supplier: A company that provides electricity, natural gas, fuel oil, or other sources of energy to a building. (See **Energy Source**.)

Expenditures: Funds spent for the energy consumed in, or delivered to, a building during a given period of time. For this report, all expenditure statistics are presented on an annual basis, for the calendar year. The total dollar amount includes State and local taxes, fuel adjustment charges, system charges, and demand charges. The total dollar amount excludes merchandise, repair charges, and service charges. Expenditure statistics are given in both nominal and real (the base weight year is 1987) dollars. (See **Consumption, Energy Supplier, Nominal** and **Real (1987)**.)

Floorspace: See **Commercial Floorspace** and **Residential Floorspace**.

Fuel: See **Energy Source**.

Fuel Oil: See **Energy Source**, *Fuel Oil.*

Gallon: A volumetric measure equal to 4 quarts (231 cubic inches) used to measure fuel oil. Forty-two gallons equal one barrel.

GDP: See **Gross Domestic Product (GDP)**.

Gross Domestic Product (GDP): The total market value of all the goods and services produced by a nation during a specified period.

HDD: See **Heating Degree-Days (HDD).**

Heating: See **Energy End Use**, *Heating.*

Heating Degree-Days (HDD): A measure of how cold a location was over a period of time, relative to a base temperature. In this report, the base temperature used is 65 degrees Fahrenheit (approximately 18 degrees Celsius), and the period of time is 1 year. The heating degree-days for a single day are the difference between the base temperature and the day's average temperature if the daily average is less than the base, and zero if the daily average temperature is greater than or equal to the base temperature. The heating degree-days for a longer period of time are the sum of the daily heating degree-days for days in that period. One degree-day Fahrenheit equals five-ninths of a degree-day Celsius. (See **Cooling Degree-Days (CDD)**.)

Household: A family, an individual, or a group of up to nine unrelated persons occupying the same housing unit. "Occupy" means the housing unit was the person's usual or permanent place of residence at the time of the first field contact. Household members include babies, lodgers, boarders, employed persons who live in the housing unit, and persons who usually live in the household but are away traveling or in a hospital. The household does not include: (1) persons who are normally members of the household but were away from home as college students or members of the armed forces at the time of the contact; (2) persons temporarily visiting with the household if they have a place of residence elsewhere; (3) persons who eat meals with the household but usually lodge or sleep elsewhere; (4) domestic employees or other persons employed by the household who do not sleep in the same housing unit; and (5) persons who are former members of the household, but have since become inmates of correction or penal institutions, mental homes, convents or monasteries, or other places in which residents may remain for long periods of time. By definition, in the RECS, the number of households is the same as the number of occupied housing units. (See **Housing Unit** and **Residential Building**.)

Housing Unit: A house, an apartment, a group of rooms, or a single room if it is either occupied, or intended for occupancy, as separate living quarters by a family, an individual, or a group of one to nine unrelated persons. Separate living quarters means the occupant(s) (1) live and eat separately from other persons in the same house or apartment and (2) have direct access from the outside of the building or through a common hall (i.e., one can get to it without going through someone else's living quarters). Hotel and motel rooms are considered housing units if occupied as the usual or permanent place or residence. Housing units do not include group quarters, such as prisons or nursing homes where ten or more unrelated persons live. (See **Household** and **Residential Building**.)

Kerosene: See **Energy Source**, *Kerosene.*

Kilowatthour (Kwh): A unit of work or energy, measured as 1 kilowatt (1,000 watts) of power expended for 1 hour. (See **Btu**, **Consumption**, and **Energy Source**, *Electricity.*)

Lighting: See **Energy End Use**, *Lighting.*

Liquefied Petroleum Gas (LPG): See **Energy Source**, *Propane.*

LPG: See **Liquefied Petroleum Gas (LPG).**

Manufacturing: See **Energy End Use**, *Manufacturing.*

Metric Conversion Factors: In this report, estimates are presented in customary U.S. units. Floorspace estimates may be converted to metric units by using this relationship: 1 square foot is approximately equal to .0929 square meters. Energy estimates may be converted to metric units by using this relationship: 1 Btu is approximately equal to 1,055 joules. (See **Btu.**)

Multistage Area Probability Sample: A sample design executed in stages with geographic "clusters" of sampling units selected at each stage. This procedure reduces survey expense while maintaining national coverage.

Natural Gas: See **Energy Source,** *Natural Gas.*

Nominal: Energy expenditures that include the effects of changes in the purchasing power of the dollar due to inflation. (See **Expenditures** and **Real (1987)**.)

Office Equipment: See **Energy End Use**, *Office Equipment.*

Other End Uses: See **Energy End Use**, *Other.*

Pounds (District Heat): A weight quantity of steam; also used in this report to denote a quantity of energy in the form of steam. The amount of usable energy obtained from a pound of steam depends on its temperature and pressure at the point of consumption and on the drop in pressure after consumption. (See **Btu, District Steam,** and **District Heat.**)

Primary Electricity: The amount of electricity delivered to buildings adjusted to account for the energy used to produce the electricity. That is, primary electricity is site electricity plus the amount of energy lost during generation, transmission, and distribution of electricity. (See **Energy Source**, *Electricity*, **Consumption**, and **Site Electricity**).

Primary Energy: The energy embodied in energy sources. Primary energy takes into account the amount of energy used to produce and deliver energy sources. (See **Consumption.**)

Primary Sampling Unit (PSU): The sampling units selected at the first stage in a multistage area probability sample. A PSU typically consists of one to several contiguous counties--for example, a metropolitan area with surrounding suburban counties. (See **Multistage Area Probability Sample.**)

Principal Building Activity: The activity or function occupying the most floorspace in a commercial building. The categories were designed to group buildings that have similar patterns of energy consumption. (See **Commercial Building, Commercial Floorspace**, and **Type of Housing Unit.**)

The principal building activity categories used in this report are described below.

> **Assembly**: signifies buildings used for the gathering of people for social, recreational, or religious activities, whether in private or nonprivate meeting halls.
>
> **Education**: refers to buildings that house academic or technical classroom instruction.
>
> **Food Sales and Service**: include the retail or wholesale sale of food, such as grocery stores, and activities that involve preparation and sale of food and beverages for consumption, such as restaurants.
>
> **Health Care**: covers diagnostic and treatment facilities for both inpatient and outpatient care. Excluded from this group are skilled nursing or other residential care facilities (nursing homes). These buildings are classified as "Lodging" buildings.
>
> **Lodging**: refers to buildings that offer multiple accommodations for short-term or long-term residents (including nursing homes).
>
> **Mercantile and Service**: refers to buildings containing sales and displays of goods or services (excluding food).
>
> **Office**: refers to buildings used for general office space, professional offices, and administrative offices.
>
> **Other**: includes parking garages, buildings used in the preservation of law and order or safety, and buildings that do not fit into any of the other named categories.
>
> **Warehouse**: describes buildings used to store goods, manufactured products, merchandise, or raw materials. This category includes both refrigerated and nonrefrigerated warehouses.
>
> **Vacant:** designates buildings in which more floorspace was vacant than was used for any single activity (as defined above) at the time of interview. A vacant building may have some occupied floorspace.

Propane: See **Energy Sources**, *Propane.*

PSU: See **Primary Sampling Unit (PSU).**

Quadrillion Btu: Equivalent to 1,000,000,000,000,000 (10^{15}) Btu. (See **Btu**.)

Real (1987): Energy expenditures in which the rate of inflation has been deducted so that purchasing power remains constant, and is expressed in 1987 dollars. (See **Expenditures** and **Nominal**)

Refrigeration: See **Energy End Use**, *Refrigeration.*

Relative Standard Error: A measure of the reliability or precision of a survey statistic. The Relative Standard Error, or RSE, is defined as the standard error of a survey estimate, expressed as a percent of the estimate. For example, an RSE of 10 percent means that the standard error is one-tenth as large as the survey estimate. (See **Standard Error**.)

Residential Building: A structure used primarily as a dwelling for one or more households. (See **Household** and Appendix C, "Residential Building as Units of Analysis.")

Residential Floorspace: The floor area of the housing unit that is enclosed from the weather. Residential floorspace includes: basements, whether or not they contain finished space; finished and/or heated space in attics; and garages. Not included in residential floorspace are: crawl spaces, even if they are enclosed from the weather; sheds and other buildings that are not attached to the housing unit; vacant housing units; and common areas, such as hallways, stairs, elevators, or lobbies. (See **Commercial Floorspace**.)

RSE: See **Relative Standard Error**.

RSE Column Factor: An adjustment factor used to compute RSE's. For a survey estimate in a particular row and a column of a table (that is, a particular "cell"), the approximate RSE is obtained by multiplying the RSE row factor by the RSE column factor for that cell. (See **Relative Standard Error** and **RSE Row Factor**.)

RSE Row Factor: A factor used to compute RSE's. The row factor is equal to the geometric mean of the RSE's in a particular row of the main tables. For a survey estimate in a particular row and column of a table (that is, a particular "cell"), the approximate RSE is obtained by multiplying the RSE row factor by the RSE column factor for that cell. (See **Relative Standard Error** and **RSE Column Factor**.)

Sampling: The procedure used to select a group of individual cases for interview from the total population. (See **Multistage Area Probability Sampling**.)

Site Electricity: The amount of electricity delivered to the site (building), without adjustment for the energy consumed in generation, transmission, and distribution of electricity. (See **Consumption**.)

Site Energy: The amount of energy delivered to the site (building); no adjustment is made for the energy consumed to produce and deliver energy sources. (See **Consumption**.)

Space Heating: See **Energy End Use**, *Space Heating.*

Square Footage: Floorspace, in units of square feet. One square foot is approximately equal to 0.0929 square meters. (See **Floorspace** and **Metric Conversion**.)

Standard Error: A measure of the precision of an estimate, equal to the square root of the variance. (See **Variance**, and **Relative Standard Error (RSE)**.)

Total Square Footage: Square footage of floorspace summed or aggregated over all buildings in a category. In this report, aggregate square footage was estimated by multiplying each building's square footage by its weight, then summing over all sample buildings of interest to represent nationwide totals. (See **Commercial Floorspace**, **Residential Floorspace**, and **Weight**.)

Trillion Btu: Equivalent to 1,000,000,000,000 (10^{12}) Btu. (See **Btu**.)

Type of Housing Unit: Categories designed to group housing units that have similar patterns of energy consumption.

> **Single-Family**: A housing unit that provides living space for one household or family. The structure may be detached or attached to another unit. Attached houses are considered single-family houses as long as the house itself is not divided into more than one housing unit and has an independent outside entrance. A single-family house is contained within walls that go from the basement (or the ground floor, if there is no basement) to the roof. Townhouses, rowhouses, and duplexes are considered single-family attached housing units, as long as there is no household living above another one within the walls that go from the basement (or ground floor if no basement) to the roof to separate the units. A mobile home with one or more rooms added is classified as a single-family home.
>
> **Mobile Home**: A housing unit built on a movable chassis and moved to the site. It may be placed on a permanent or temporary foundation and may contain one or more rooms. If rooms are added to the structure, it is considered a single-family housing unit. A manufactured house assembled on site is a single-family housing unit, not a mobile home.
>
> **Multifamily (two to four units)**: A housing unit in a building with two to four housing units (i.e., a structure that is divided into living quarters for two, three, or four families or households).
>
> **Multifamily (five or more units)**: A housing unit in a building with five or more housing units (i.e., a structure that contains living quarters for five or more families or households).

Vacant: As a principal building activity, the designation for a commercial building in which most of the floorspace was not occupied by any tenant or establishment. A vacant commercial building may contain occupants who are using up to 50 percent of the floorspace. The CBECS also measures vacancy in terms of the fraction of space vacant within an individual building and the fraction of time the building was in use. For all commercial buildings, data were collected on the percent of floorspace vacant three or more months, and on the number of months the building was in use. (See **Principal Building Activity** and **Vacant Housing Unit**.)

Vacant Housing Unit: A housing unit not occupied when the first RECS field contact was made. An occupied seasonal or migratory housing unit is classified as vacant at the time of the first contact if all of its occupants had a usual place of residence elsewhere. (See **Household** and **Vacant**.)

Variance: A measure of the variability of a set of observations that are subject to some chance variation, equal to the expected squared difference between a single observation and the average of all possible observations obtained in the same manner. The variance is the square of the standard error of estimates. For statistics presented in this report, the variance indicates the likely difference between the value computed from the CBECS sample and the average of the values that could have been computed from all possible samples that might have been obtained by the same sample selection process. (See **Standard Error**.)

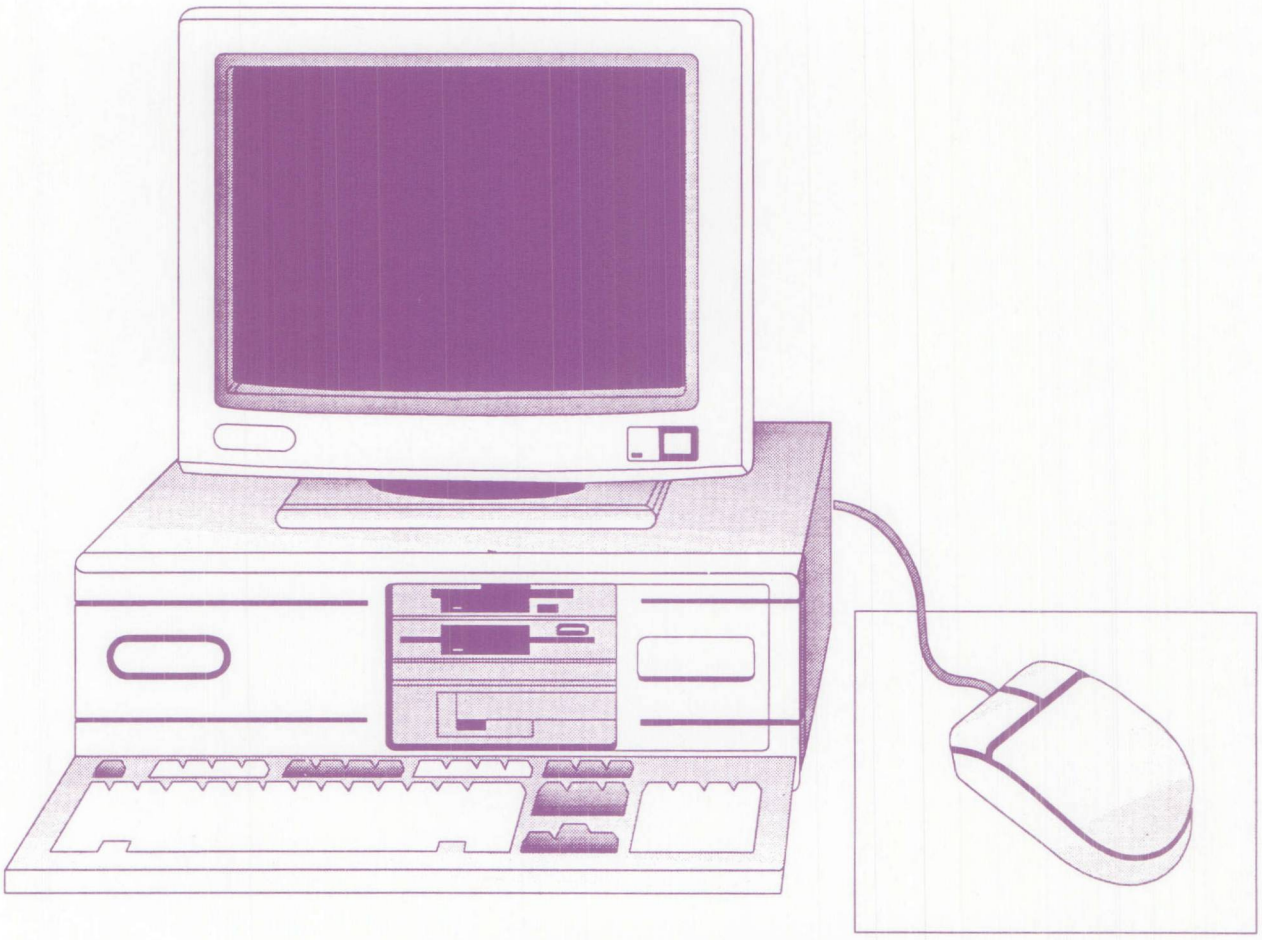
Ventilation: See **Energy End Use**, *Ventilation.*

Water Heating: See **Energy End Use**, *Water Heating.*

Weight: The number of cases in the total population that a particular sample case represents. To estimate the total value of a characteristic in the total population, each case's value is multiplied by the case's weight. Summing the weighted sample values provides an estimate of the population total. (See **Multistage Area Probability Sample**.)

Wood: See **Energy Source**, *Other.*

Year Constructed: The year in which the major part or the largest portion of a commercial building was constructed. The year the residential structure was originally completed or the year any part of the structure was first occupied. For mobile homes, year of construction is the model year.



CBECS/RECS Data on Diskettes

The public use data for the 1992 Commercial Buildings Energy Consumption Survey (CBECS) and the 1993 Residential Energy Consumption Survey (RECS) are both available on diskettes.

- For IBM-PC and compatible microcomputers
- 3-1/2 inch double-sided, high-density diskette
- Flat ASCII format
- Dbase format
- Contains a READ.ME DOS text file
- Technical document file

For ordering information contact:

Office of Scientific and Technical Information (OSTI)
P.O. Box 62
Oak Ridge, TN 37831
(615) 576-8401

National Technical Information Service
5285 Port Royal Road
Attention: Order Control
Springfield, VA 22161
(703) 487-4650

Energy Information Administration
U.S. Department of Energy
Forrestal Building, EI-231
Washington, DC 20585

Address Correction Requested